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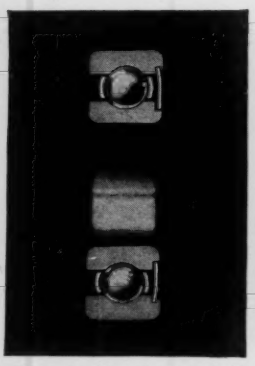
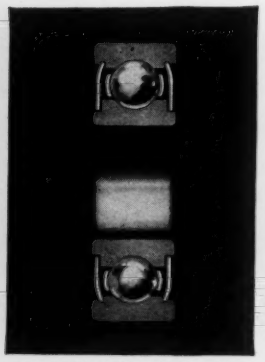
MACHINE DESIGN

AS IT AFFECTS

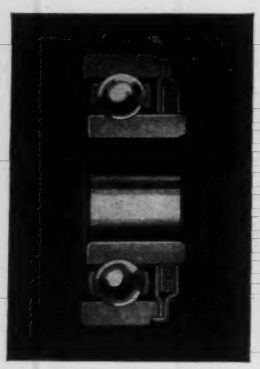
ENGINEERING—PRODUCTION—SALES



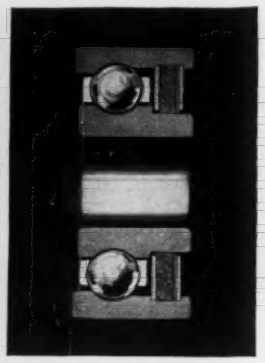
Type P—Closed type ball bearing with one grease-retaining plate.



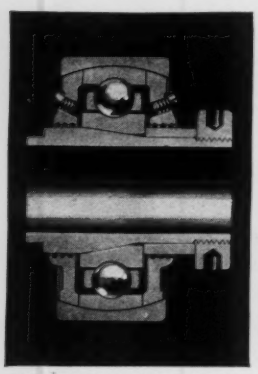
Type PP—Closed type ball bearing with two grease-retaining plates.



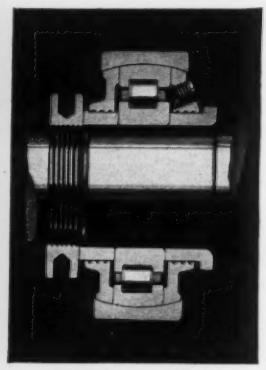
Type GS—"Greaseal" felt-protected, grease-packed ball bearing.



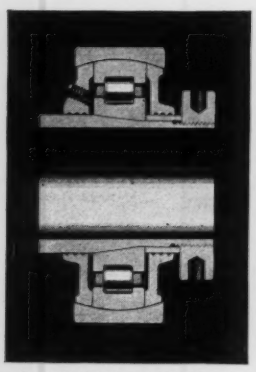
Type EGS—Adjustable, felt-protected, grease-packed ball bearing.



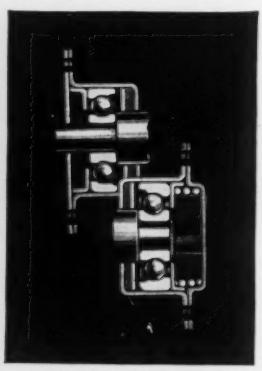
Type LTW — Self-aligning ball bearing with swiveling grease-retaining side plates and adapter sleeve.



Type RLSW — Self-aligning roller bearing with swiveling grease-retaining side plates.



Type RLTW—Self-aligning roller bearing with swiveling grease-retaining side plates and adapter sleeve.



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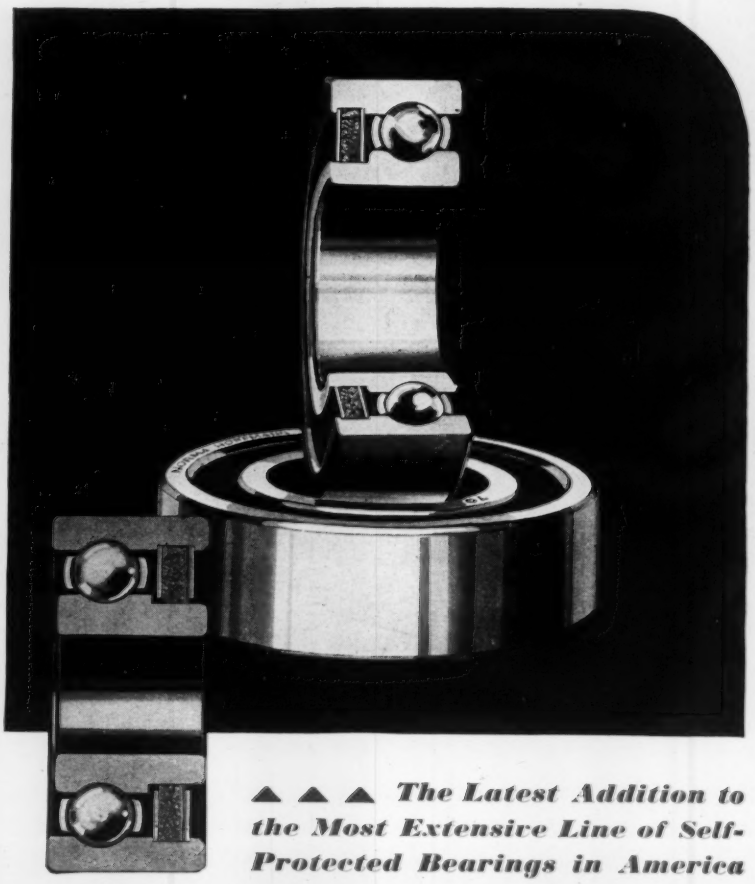

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MACHINE DESIGN

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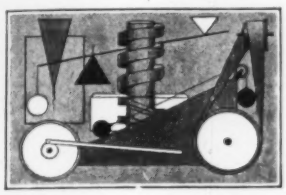
ENGINEERING–PRODUCTION–SALES

Volume 3 **September, 1931** **Number 9**



Forthcoming ISSUES

ONE of the primary aims of MACHINE DESIGN *is to assist engineers responsible for design in the selection and application of machine parts and materials. Discussions in the current issue cover the properties, characteristics and application of cork, and the advantages of shapes, as machine details.*

In a forthcoming issue will be presented a contribution on the subject of steel balls for uses other than as integral parts of antifriction bearings. Many unique applications will be brought to light. Perusal of this article undoubtedly will convince designing engineers that the steel ball is not merely a minor part, but one worthy of serious consideration in the solution of many types of problems.

L. E. Jermy

Managing Editor

CONTENTS

(FOR COMPLETE ITEMIZED INDEX OF CONTENTS, SEE PAGE 7)

	Page
Co-ordinating Design Activities With Company Management *By L. E. Jermy*	27
Scanning the Field for Ideas	30
Reversing Engines Feature U. S. S. Akron	33
Designing Bolts for Shock Loads *By J. I. Clower*	36
Cork Becomes Increasingly Popular as Design Material *By A. F. Clark*	37
Composite Steel Resists Corrosive Forces	40
Bringing Gearing Formulas Up to Date *By G. H. Middleton*	41
Vacuum Principle Believed Failure in Harvesting Machine *By D. Scoates*	45
Cold Drawn Shapes and Extruded Sections Offer Economy in Designing *By H. B. Veith*	48
Is There an Untapped Market in Your Industry? (Editorial)	52
Early Machines—Developing the Cotton Picker	53
Professional Viewpoints	54
Men of Machines	56
Leaders in Design, Engineering and Research	57
Assets to a Bookcase	60
Topics of the Month	62
Noteworthy Patents	66
How Is Business?	70
New Materials and Parts	72
New Blueprinting Machine Has Improved Drier	88
Manufacturers' Publications	90
Business Announcements and Sales Briefs	94
Advertising Index	96
Calendar of Meetings and Expositions	24

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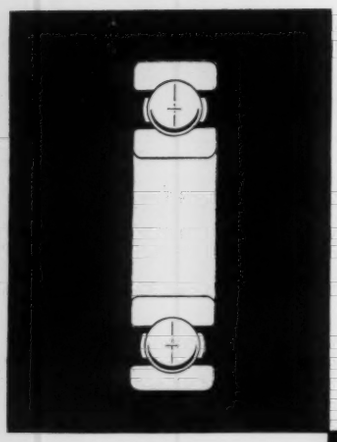

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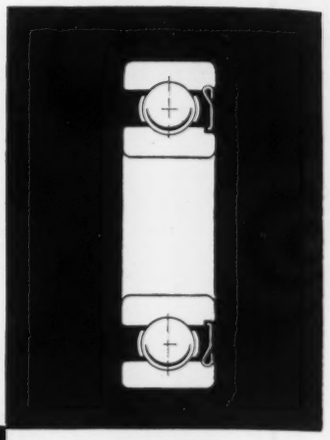
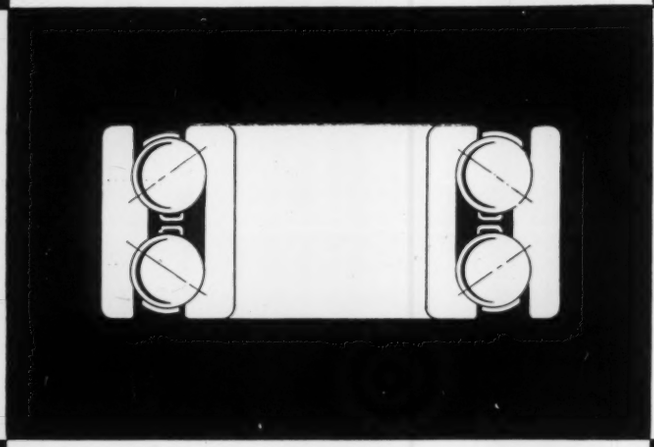
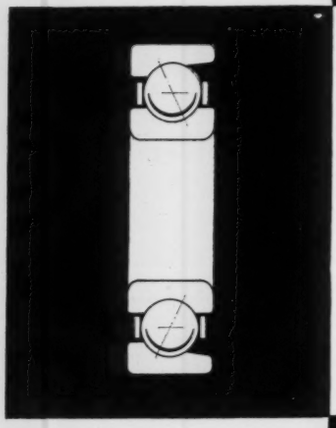


SINGLE ROW — Used where radial loads predominate. Built in both maximum capacity and non-loading groove types. All tolerances conform to S.A.E. limits or closer. Where extreme precision is required, New Departure is well equipped to fill your needs.



SHIELDED—Essentially a single row radial bearing fitted with metal shield to exclude foreign matter and retain non-fluid lubricant. In hard-to-get-at places engineers specify shielded New Departures because of their better protection from dirt and wear.



DOUBLE ROW—For locating shafts and gears with exactness and rigidity, the double row is the simplest unit. Preloading eliminates all looseness and end-play. An angular contact design fits it for heavy thrust loads. It is the popular choice for drill spindles, speed reducers, portable tools, idler pulleys, automobile pinions and a host of other applications.

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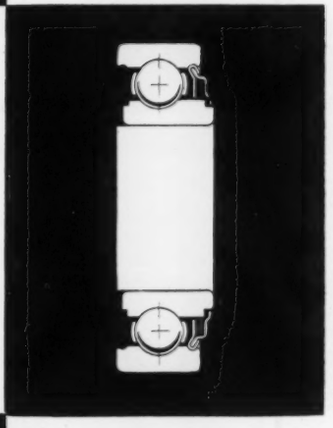
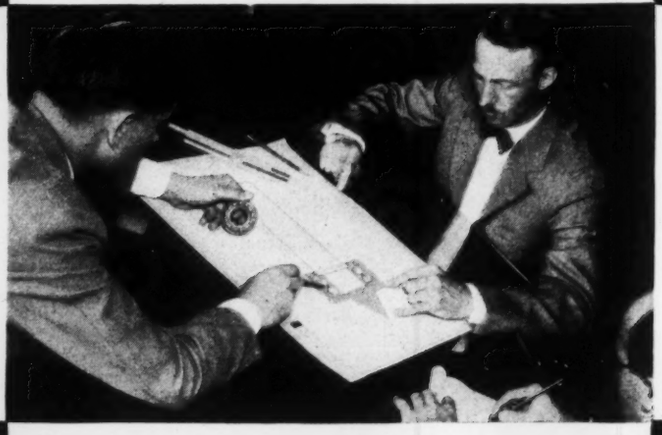


RADAX—A single row angu ar contact bearing used for positive location of parts which operate under heavy thrust or combined loads. Made in Perfex grade for applications requiring extreme accuracy, such as machine tool spindles, etc.



N-D-SEAL—A bearing with an inbuilt seal of felt and metal . . . charged with sufficient lubricant before shipment for several years' operation. Other economies and conveniences are described in Booklet N. Send for a copy.

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Itemized Index, September, 1931

Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

Compiled for the assistance of engineers confronted with specific design problems

Design Calculations:

Bolts for Shock Loads, Edit. 36
Gearing, Edit. 41, 42, 43, 44
Theory of Elasticity, Edit. 60L

Design Problems:

Centralizing Controls, Edit. 31R, 32
Changing Engine Timing, Edit. 34R, 35L
Eliminating Machining, Edit. 48, 49, 50, 51
Evaluating Finishes, Edit. 31
Sealing Bearings, Edit. 38, 39
Starting Engines, Edit. 35L

Finishes:

Rust Proofing, Adv. 16
Testing, Edit. 31

Materials:

Alloys (General), Edit. 60R
Alloys (Nickel), Adv. 69
Alloys (Nickel Chrome), Edit. 40
Alloys (Steel), Adv. 18
Babbitt Metal, Edit. 78R
Cork, Edit. 37, 38, 39, 40; Adv. 93
Magnesium, Edit. 32, 51R
Rubber, Edit. 47R

Mechanisms:

Engine Reversing, Edit. 33, 34, 35
Pneumatic Gear Setting, Edit. 66
Propeller Swiveling, Edit. 33, 34
Speed Changing, Edit. 66R, 68L
Stripping, Edit. 46, 47

Organization and Equipment

Of Engineering Department, Edit. 27, 28, 29, 54, 55L, 88R; Adv. 25

Parts:

Bearings, Edit. 33R, 34L, 55R, 72L; Adv. 2, 6, 15, 21, 23, 59, 65, 71, 79, 85, 88L, 91, 96L
Clutches, Edit. 32L, 35L, 39R, 72R
Controls (Electrical), Edit. 74L, 76L, 78R, 80, 82; Adv. 8, 9, 75
Couplings, Adv. 73
Die Castings, Adv. 99
Drives, Edit. 66R, 68L, 82; Adv. 3, 4, 17 63, 81, 84L
Fastenings, Edit. 76R; Adv. 19, 77
Flexible Shafts, Edit. 68
Forgings (Brass), Adv. 61
Gears, Edit. 41, 42, 43, 44
Generators (Electric Steam), Edit. 74R
Hose (Rubber), Edit. 31R
Molded Parts, Adv. 92L
Motors, Edit. 76L, 78L, 80L, 84R, 86R; Adv. 10, 11, 14, 26, 83, 89
Packings Glands and Packing, Edit. 38, 39, 78L; Adv. 22, 87, 96L
Plugs (Electrical), Edit. 72L; Adv. 13
Pumps, Adv. 97
Shapes, Edit. 48, 49, 50, 51
Stampings, Adv. 67
Tubes (Steel), Adv. 20
Welded Parts and Equipment, Edit. 84R; Adv. 86L, 95, 98, 100

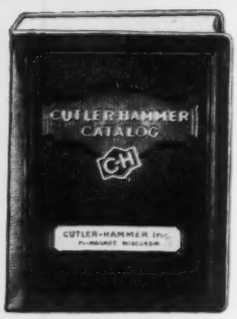
Principles:

Vacuum, Edit. 31R, 32L, 45, 46

DESIGN, in this age, includes not only practical application of the mechanics of machinery and the drawing of plans, but also consideration of the effect of design on sales. And above all it implies a thorough knowledge of materials and parts, and particularly close familiarity with the sources from which they can be obtained.

Settle that

and you open



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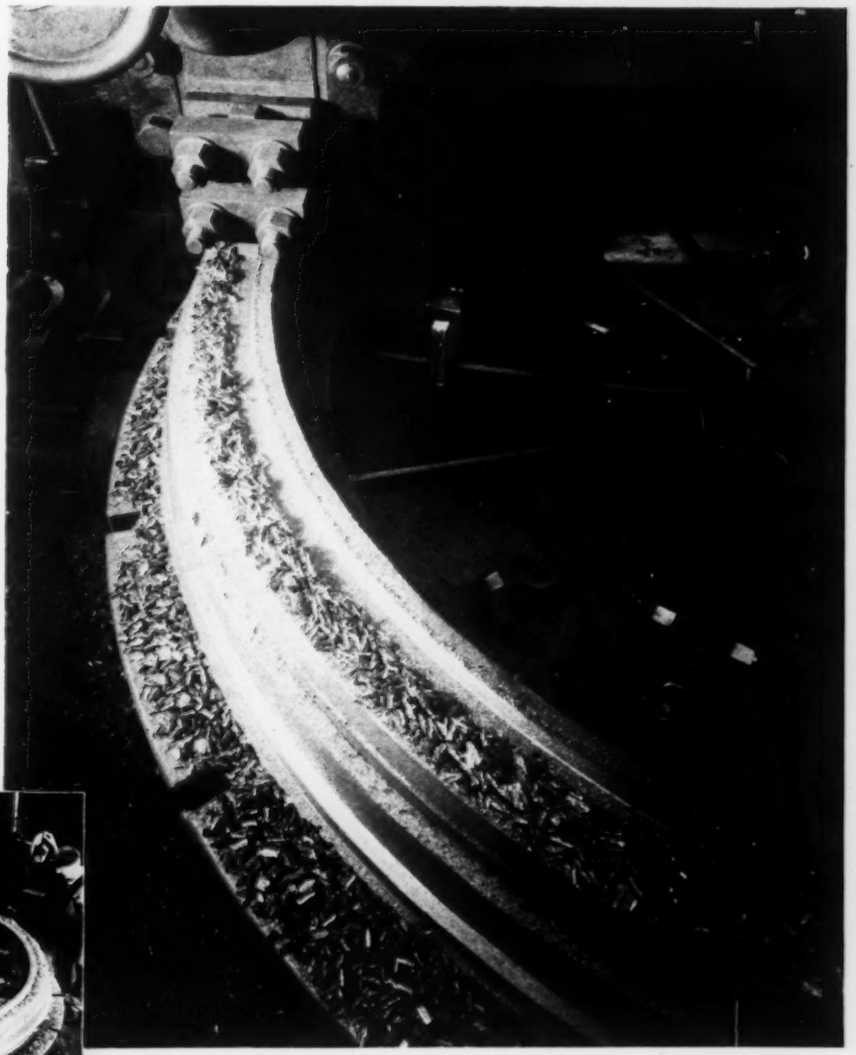

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And in a bearing, of course, there's nothing but performance that counts

THERE'S no engineering degree required to appreciate the fact that a machine can't do a precision job if it is not equipped with precision bearings.

That is almost as obvious as the axiom of the square peg and the round hole. You know that. The leaders among machine tool manufacturers know it, too. For what other reason would one hundred and forty-three of them use SKF?

SKF Anti-Friction Bearings have always been designed to fit the job—never to fit a price. SKF tolerances . . . the extent to which deviation from the perfect in bearing parts is tolerated . . . are measured in *one ten-thousandth* parts of an inch!

SKF Anti-Friction Bearings could be made for less money if SKF were content that they should do *less* of a job.

Yet, in a bearing, there's nothing but performance that counts...nothing. SKF Industries, Inc., 40 East 34th Street, New York, N. Y.

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Calendar of Meetings and Expositions

Sept. 16-18—National Electrical Manufacturers association. The annual fall meeting will be held at the society's headquarters, 420 Lexington avenue, and Hotel Commodore, New York. Information on the meetings may be obtained from Mrs. Alice M. Hopf, 420 Lexington avenue, New York.

Sept. 17—Steel Founders Society of America. First fall meeting to be held at Chicago. Granville P. Rogers, 932 Graybar building, New York, is general manager.

Sept. 21-25—American Society for Steel Treating. Papers to be presented at the National Metal congress and exposition to be held at Commonwealth pier and Hotel Statler, Boston, include: "Comparison of Sheet and Strip Steels for Difficult Stampings," by Edw. S. Lawrence; "Behavior of Some Irons and Steels Under Impact at Low Temperatures," by Robert Sergeson; "Characteristics of Alloyed Cast Iron," by F. W. Shipley; "Precious Metal Alloys," by R. C. Brumfield; and "Inspection of Welds with Gamma Rays," by Gilbert E. Doan. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is secretary of the society.

Sept. 21-25—American Institute of Mining and Metallurgical Engineers. Meeting of the iron and steel and institute of metals divisions to be held in conjunction with the National Metal congress, Hotel Statler, Boston. Papers to be presented include: "Low Carbon Steels," by H. B. Pulsifer; "Copper Embrittlement," by L. L. Wyman; "Influence of Stress on Corrosion," by D. J. McAdam Jr.; and "Age-Hardening Copper-Titanium Alloys," by F. R. Hensel and E. I. Larsen. W. M. Corse, 29 West Thirty-ninth street, New York, is secretary.

Sept 21-25—American Welding society. Subjects to be discussed at the six sessions held in conjunction with the National Metal Congress, Hotel Statler, Boston, include: Manual and automatic welding; welding of nonferrous metals; corrosion resistant steels; welding of machine parts; and other applications. M. M. Kelly, 33 West Thirty-ninth street, New York, is secretary.

Sept. 26-Oct. 2—American Electric Railway association. Annual meeting and exposition at Atlantic City. Guy C. Hecker, 292 Madison avenue, New York, is general secretary.

Sept. 28-30—American Mining Congress and American Institute of Mining and Metallurgical Engineers. Ninth annual meeting of western division of congress and regional meeting of engineers to be held jointly with headquarters in Connor hotel, Joplin, Mo. J. F. Callbreath, Munsey building, Washington, D. C., is secretary of the congress.

Oct. 7-8—Society of Automotive Engineers. Production meeting to be held at Book-Cadillac hotel, Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Oct. 12-16—American Gas association. Thirteenth annual convention and exposition at Municipal auditorium, Atlantic City, N. J. Kurwin R. Boyes, 420 Lexington avenue, New York, is secretary.

Oct. 12-16—National Safety council. Annual meeting and exposition at Stevens hotel, Chicago. W. H. Cameron, 20 North Wacker drive, Chicago, is secretary.

Oct. 14-16—Society of Industrial Engineers. Annual meeting to be held in Pittsburgh. Geo. C. Dent, 205 W. Wacker drive, Chicago, is secretary.

Oct. 15-16—American Society of Mechanical Engineers. Sixth national meeting of wood industries division to be held at Robert E. Lee hotel, Winston Salem, N. C. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary.

Oct. 15-16—Gray Iron institute. Fourth annual meeting at West Baden Springs hotel, West Baden, Ind. Arthur J. Tuscany, Terminal Tower building, Cleveland, is manager.

Oct. 15-17—American Gear Manufacturers association Semiannual meeting of the association to be held at William Penn hotel, Pittsburgh. T. W. Owen, 3608 Euclid avenue, Cleveland, is secretary.

Oct. 17-22—Southern Textile Exposition. Tenth annual exposition to be held at Textile hall, Greenville, S. C. William G. Sirrine, Greenville, S. C., is exposition manager.

Oct. 21—Association of Railway Electrical Engineers. Annual meeting at Sherman hotel, Chicago. J. Andreucetti, 520 W. Madison street, Chicago, is secretary.

Oct. 21-23—National Association of Farm Equipment Manufacturers. Annual meeting at Congress hotel, Chicago. H. J. Sameit, 608 South Dearborn street, Chicago, is secretary.

Oct. 23—American Iron and Steel institute. Annual meeting at Hotel Astor, New York. E. A. S. Clarke, 75 West street, New York, is secretary.

Oct. 26-31—Dairy and Ice Cream Machinery and Supplies association. Annual meeting and exposition at Atlantic City, N. J. C. E. Breece, 225 West Thirty-fourth street, New York, is secretary.

MACHINE DESIGN
THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO
September, 1931 Vol. 3—No. 9

Co-ordinating Design Activities with Company Management

By L. E. Jermy
Managing Editor, Machine Design

IN THE exchange of opinions bearing upon the relations of the engineering and sales departments, published in the last two issues of MACHINE DESIGN, the responsibility of management in co-ordinating design and sales activities was emphasized by numerous commentators.

Many engineers, defending their profession against charges hurled by "Machinery Salesmen," declared that much of the blame for the conditions outlined by the salesman-critic rests on the shoulders of management and not upon those of the engineering department.

From this and other competent evidence it is clear that there is room for improvement in the general conception of relations between engineering and management. The responsibility of the company executives insofar as it pertains to engineering activities should be more clearly defined. Likewise there should be a better understanding of what management expects of the engineering department.

Anyone who is familiar with the internal problems of companies engaged in the manufacture of machinery knows that misunderstandings on these points are common. In numerous instances presidents are not entirely satisfied with the functioning of the engineering departments, but do not know where the trouble lies. As often as not, the chief executive concludes that engineers are temperamental or queer, and gives up trying to understand them.

On the other hand there are hundreds of able heads of engineering departments who are constantly on "pins and needles" because they cannot figure out what management expects of them. In a number of establishments if

SMOOTH functioning of the engineering, sales and production departments depends largely upon the attitude of company management toward each. Therefore if the design activities of the engineering staff are to be effective, the chief of engineering must know what management expects of his department.

On the following pages MACHINE DESIGN presents a summary of the qualities and services which executives of machinery building concerns believe are essential to good engineering. The article is a composite of the views held by a score of officers entrusted with management.

Next month the engineers' opinion of management will be presented.

—The Editors

the engineer asserts undue initiative and tries to help out in matters of broad company policy, he is told to get back into his own department and to attend to his own business. In other plants, engineers who restrict their activities solely to the affairs of engineering are condemned for not participating more freely in the broader problems of company administration.

In view of this wide diversity in the functions of engineering departments, it is desirable that the views of management be surveyed to the end that something definite can be determined as what company executives expect of engineering staffs. The task is difficult because the conditions differ, not only in each branch of industry, but in plants within each industrial group.

Nevertheless there are certain fundamentals that are common regardless of local or special conditions. If these basic qualities can be enumerated and agreed upon, the road to understanding can be made smoother.

In the accompanying article, built upon the views of many company executives, emphasis is placed on six factors which they consider of primary importance: Sound engineering knowledge, good "business sense," initiative, re-

What We Expect of the Engineering D

AT THE outset it must be admitted that no one individual can set down a definite formula for engineering functioning that could be applied universally because the work required of engineers differs in every organization.

In a small establishment where the product is comparatively simple, the engineering department conceivably may consist of one man who is not much more than a glorified draftsman. At the other extreme is the chief engineer of a gigantic corporation manufacturing hundreds of intricate mechanical devices whose responsibilities, ability and salary rate him far above the highest executive officer of an industrial concern of moderate size.

But in spite of the sharp contrasts in the requirements imposed by different types and sizes of plants, there are certain characteristics in engineering personnel which are desirable under almost all conditions.

First of all the engineering department should "know its stuff." More than that, the engineer in charge should be able to convince others in the organization of that fact.

"Can support his judgment with convincing explanations"

It is very disconcerting for the president of a company, when consulting his chief engineer on a technical problem, to gain the impression that the engineer is not sure of his ground.

On this point experience seems to indicate that the trouble lies not so much in the failure of engineers to exercise good engineering judgment as in their inability to convince others of their knowledge. Hundreds of able technical men do not rise to the heights of which they are capable simply because they have not mastered the trick of "selling" either themselves or their ideas to others.

When the expenditure of a fairly large sum of money depends on the soundness of an application of engineering, the executive responsible for the company's finances wants to be reasonably sure he is right. The engineer who can support his judgment with convincing explanations soon wins the confidence of management. The engineer who is never sure of himself, or who tries to evade his responsibility in this respect, finds it increasingly difficult to gain the sympathetic ear of management.

The president of a company in which design is important always welcomes a reasonable attitude on the part of engineers. The chief executive is supposed to co-ordinate the activities of the various departments. Frequently it happens that certain refinements in design necessitate delicate adjustments in the various features strongly demanded by the engineering, sales, production, cost and purchasing departments. Naturally there must be considerable give-and-take and management expects each department head to hold out strongly for essentials but to give in gracefully on demands which cannot be justified in light of known circumstances. The best engineers are reasonable in these negotiations, but many a stubborn technical man has caused unnecessary trouble by holding out unreasonably for the sake of a "pet" detail of design. We want engineers who will stick to the last ditch when they are right, but who do not hold up the work to nurse along a cherished idea because of undue or unwarranted sensitiveness about "pride of profession."

The problem of initiative in engineering is a delicate one. How far the engineering department should go in scouting for new ideas always will depend on many conflicting factors, one of which is the business sense of the engineer in charge. In a large measure the initiative displayed in the engineering department is governed either by company policy or by the extent of the budget for design and engineering work. Yet given the same amount of money and the same freedom of action, two chief engineers will produce widely different results.

One will remain strictly within the boundaries of his department, insisting that everyone wanting to consult him come to him. He never proposes an improvement

sourcefulness, adaptability and open-mindedness.

The list—admittedly incomplete—is sufficiently representative to indicate that the management prefers many qualities which lie outside of the limits of "pure" engineering. Business sense, for instance, is an attribute which requires a knowledge of sales, competition, buying habits, economics and other subjects beyond the confines of "straight" engineering. In fact, the statement of what management expects of engineering departments confirms and emphasizes the views expressed in the first article of this series; namely, that if engineers are to take full advantage of their opportunities they must revise their conception of the scope of engineering. They must broaden their activities to include greater familiarity with commercial problems.

In brief, management seeks engineering that is suited to the practical needs of manufacturing. Management is interested in the method by which engineering is applied even more than it is concerned with engineering itself. It is the service actually delivered to the company by engineering that counts—not the store of engineering knowledge lying unused in the engineering department!

Department—By a Group of Executives

unless specifically asked to do so. He meets every demanded requirement fully but he never offers advice or services on his own initiative.

The other engineer will contribute ideas and suggestions to all departments and often will participate in formulating important company policies. His better appreciation of what is going on in sales and production makes him a better chief of engineering.

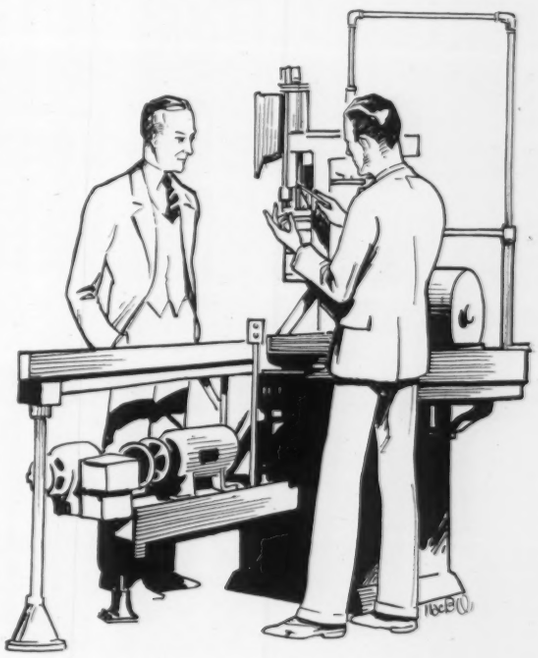
From the standpoint of management, the self-starter is preferable to the man who sticks strictly to his own department, but it should be remembered that not every company encourages initiative. In many establishments a succession of self-sufficient, unco-operative engineers has dulled the appreciation of engineering initiative to the extent that the executives do not expect more of the present incumbent and do not offer him much encouragement to assert his self-starting proclivities.

Many engineers lack what may be termed "business sense." William Le Roy Emmet of the General Electric Co. states the case clearly in his book "The Autobiography of an Engineer" when he writes: "Some of the most expert men who are responsible for engineering designs may be so tied down by the routine demands of their calling that they cannot sufficiently know the conditions of commercial demand or the needs imposed by competition."

The management of any company is fortunate if it has an engineer who is able to combine good engineering with sound business judgment. The engineer who does not know the commercial and competitive conditions under which his company's product is offered to consumers is not giving complete service because his deficiency in this respect has to be supplied from some other source in the organization.

Those responsible for the executive management of a company appreciate the quality of resourcefulness in the engineering staff. To be resourceful the chief engineer must be able to rise to emergencies and to organize his forces to carry a peak load when it is necessary.

As an illustration, assume that the company is considering the purchase of the rights of a machine, with the idea of utilizing certain basic features in it but improving many of its details. Before finally committing themselves to the purchase, the officers want a rough estimate of the changes required and what will be involved by the changes. Here is where the resourceful engineer has a marked advantage over the one with an inflexible method of working. He resorts to numerous short cuts which he has developed through past experience. He is able to present the required data and conclusions without dotting every "i" and crossing every "t". He has an uncanny ability to sense just what the company officers want and he wastes no time in digging up information that is not required.



"Some engineers are too prone to adopt the attitude: 'It can't be done!'"

An open-minded attitude is a desirable characteristic for engineers. Management frequently has to contend with an engineering department which automatically puts its foot down hard on suggestions for radical changes. Too many engineers react to innovations negatively. Their first impulse is to build up an argument against it—to show why it will not work rather than to see if it can be utilized. Company officials would like to hear more statements such as "We'll look into it and see if we can use it" and fewer arbitrary pronouncements to the effect "it can't be done."

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

PROBABLY in engineering more than anywhere else, one thing suggests another. With each new invention, says John Hays Hammond, the eminent engineer, has come realization of unlimited future possibilities for improvement and endless ramifications. The telegraph suggested the telephone, both led to the wireless and television, the balloon made possible the dirigible, which in turn suggested the heavier-than-air machine, made feasible by the invention of the gas engine. Throughout this progress we see a succession of ideas breeding ideas and each multiplying tenfold; of new necessity giving birth to new invention.

Substituting for the Sun

TEN years from now it is predicted artificial drying of forage crops will be established agricultural practice. This forecast not only holds a hopeful aspect for the farmer but promises to create a new machinery market in which there will be a demand for design ideas in development of this type of agricultural equipment.

Driers or "haymakers" as they sometimes are called, incorporating some of the ideas of the tumbling barrel, the continuous drying furnace, and the cement kiln, now are being produced commercially. Experiments in artificial drying of hay have been carried on for some time with electrically driven machines known as "Airdryers" for curing crops regardless of prevailing weather conditions. These units are manufactured by the Arnold Dryer Co., Milwaukee, and are of the drum type shown in Fig. 1. A 25 horsepower General Electric motor drives the cylinder.

Agricultural departments of the United States and Canada also are experimenting with the process of artificial dehydration. At Ottawa, Canada, a machine turned alfalfa into meal within 20 minutes from the time it was cut in the field by the quick drying method, retaining over 20 per cent of the protein. The evolution of this type of machinery is unique in that instead of studying the fundamental requirements of a forage crop dehydrator and then designing a machine for this purpose, the pioneer work in this field was done by building machines from a general conception of what they should do.

At Louisiana State university, Harold T. Barr, assistant professor of agricultural engineering, is engaged with other engineers in the development of a revolving drum type of dehydrator or drier shown in Fig. 2. The hay drier they have designed is briefly an ensilage cutter for receiving the green hay and chopping it into short lengths. The chopped hay then is passed into a cyclone feeder and is fed by gravity into the high temperature end of a revolving drum, the drum being 6 feet in diameter and 40 feet long. Its speed is 12 revolutions per minute.

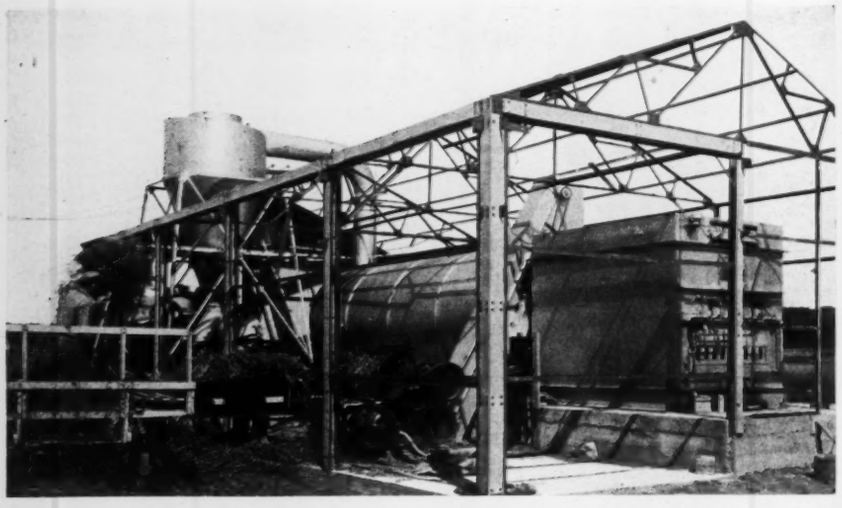


Fig. 1—Artificial hay drier of revolving drum type in operation

Shelves spaced 18 inches apart around the interior of the drum carry the hay to the top and drop it into the hot gases passing through the machine. The gases, which are a product of combustion of an oil burning furnace plus some excess air, come in direct contact with the hay. Their flow is maintained by an exhaust fan. The forward movement of the gases provides

the means of carrying the hay through the drier as well as evaporating the desired amount of moisture.

As stated in MACHINE DESIGN, January, 1931, issue, the drying part of the revolving drum type machine is similar to the pulverized coal drier. Another type of dehydrator utilizes a conveyor for passing material through a drying compartment or tunnel, approximately 150 feet long by 7 to 10 feet wide where it is exposed to heated air or gases. Heat which registers about 300 degrees Fahr. is forced into the tunnel by a large fan from a furnace. The hay is formed into a fairly uniform mat on the conveyor and the heated air forced up and down through it by suitable baffles in the tunnel.

Heat is provided in the drier developed at the Central Experimental farm, Ottawa, Canada, by twenty-eight 500 watt strip heaters arranged in two batteries of 14 strips each. These are placed in the lower section of the machine.

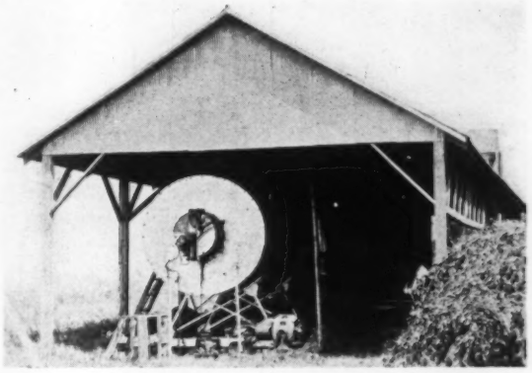


Fig. 2—Louisiana State university hay drier

Steam coils sometimes are used for heat in the tray type drier. In this type the forage is placed in two large trays with perforated bottoms and passed through the drying chamber.

Wear Testing Finishes With Sand

BECAUSE of the lack of simple methods of tests, standardization of finishes has been retarded. Recently, however, a machine employing a well known abrasive, sand, was designed at Bell Telephone laboratories, New York, to facilitate a wear test to determine the mechanical durability of finishes.

The basic idea is the contact of sand with the finish of a specimen, which is in a measure the use of the same process that has been employed in finishing floors with sandpaper machines and rubbing down painted surfaces to obtain a smooth finish for the final coat. A battery of six finish testing machines is shown in Fig. 3. Each unit has a sand chamber in which a 4-inch specimen is fastened to the top of a vertical shaft

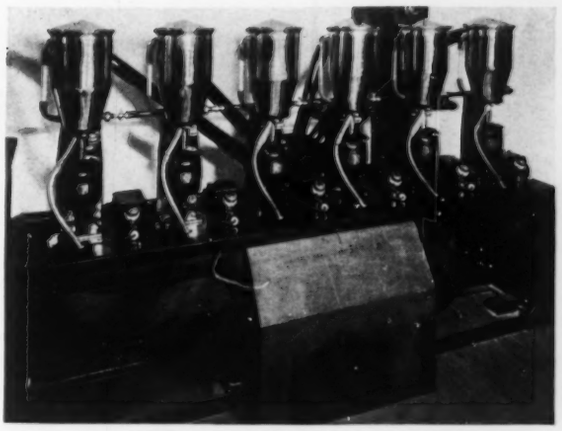


Fig. 3—Battery of finish wear testing machines

and rotated. The chamber surrounding the upper end of the shaft and the sample is filled with a standard grade of sand to a depth of 5 inches over the finished surface. A compressed air injector arrangement circulates the sand while the test is under way by taking it from the bottom and carrying it through an outside tube connection to the upper part of the sand chamber.

A suction connection is made to the upper part of the sand chamber and serves as a vacuum cleaner to remove light waste material. The circulating and cleaning arrangements act also to cool the surface of the specimen undergoing wear. Speed of the surface of the sample relative to the sand varies directly with the distance out from the center of the shaft; thus the wear increases progressively toward the periphery of the disk.

Design of the apparatus involved some interesting problems. It was desirable that the specimen be rotated with a minimum of eccentricity and this required a bearing directly beneath the specimen. Since the chamber is filled with sand from several inches below the specimen to 5 inches above, it was necessary to provide a bearing to run continuously immersed in sand, a rather difficult requirement for a bearing to meet.

Another problem arising due to the use of sand was the selection of material for the outside connection through which the sand is circulated. In experimental models rubber hose was used and found to give good service. In the refined design, however, metal tubing was tried, but this soon blasted through at the corners. The trouble was overcome by using rubber hose for the corners and metal for the straight section.

Is the Auto Clutch Pedal Doomed?

OUTSTANDING among the design developments in the automotive industry is the facility for free-wheeling by means of a clutch control. Bendix Aviation Corp., South Bend,

Ind., introduced the device recently. The vacuum principle is employed. When the foot is lifted from the accelerator the clutch is disengaged and gears may be shifted without touching the pedal. The clutch again is engaged the moment the driver presses down on the accelerator.

Waste power from the intake manifold is utilized to create a vacuum, which occurs the moment the engine reaches idling speed. The motorist may return to conventional drive by moving the hand throttle to that point at which it starts to push down the foot throttle.

Word comes from Australia that a device has been developed there which permits the removal of the clutch pedal and gear shift lever from the machine. This has been reported by Consul Henry M. Wolcott at Adelaide. A leading British motor car manufacturer is to try it.

Triple Discharge Features Mixer

MIXING of concrete at a central station and transporting it to the job has been done for some time, and observation of some of the recent developments in the design of the transport mixers is worthy of note. It has been found necessary to incorporate materials which would withstand heavy loads and the wear and tear of agitating while in transit, particularly for the rotor blades. The equipment also must be such that it can be charged, discharged and cleaned with speed and ease with a minimum of labor, to help it compete with stationary mixers.

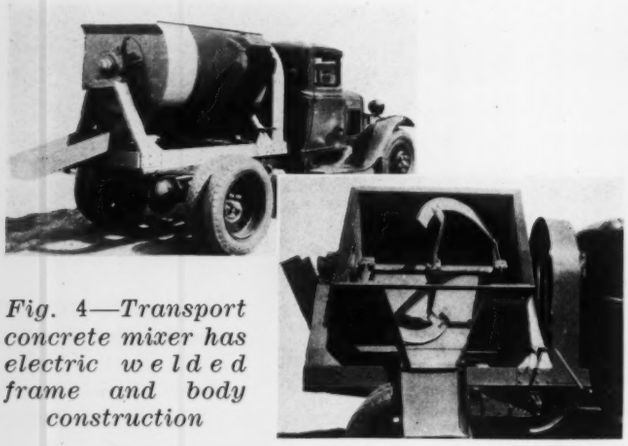


Fig. 4—Transport concrete mixer has electric welded frame and body construction

One of the units which has kept pace with present day requirements is manufactured by the Concrete Transport Mixer Co., St. Louis. It is said to be the only equipment on the market that can be discharged from either side or the rear, as shown in Fig. 4.

Device Promotes Safety in Flight

NATIONAL air races held at Cleveland recently brought to light several new developments in the industry which are of interest to the design profession. One is the general use of magnesium alloys in aircraft engine construction. G. D. Welty, Aluminum Company of America, made a prediction to this effect at the aeronautic meeting of the Society of Automotive Engineers. It is his belief that magnesium will resist corrosion successfully for most types of land service and for most saltwater flying in the middle and upper latitudes. The power-weight factor in aircraft will demand the substitution of magnesium alloys for steel and in some cases for aluminum.

Visiting Italian flyers exhibited a safety arrangement which greatly simplifies control of airplanes in flight. Lieut. Col. Mario De Bernardi, renowned military flyer and test pilot, is the inventor of the arrangement which is designed to eliminate the use of the rudder bar. With this device the pilot's feet are free, thereby obviating the necessity for human co-ordination in operating the rudder and ailerons simultaneously. This in a measure is an innovation paralleling that of the free-wheeling clutch control for automobiles previously described.

The greatest value to be derived from the device eliminating the rudder bar of the plane will be in blind flying, since it causes the plane to level out automatically when the controls are set at zero. It is claimed that with the co-ordinated control the plane cannot go into a tail spin.

Will Hot Water Engines Be Used?

HOT water engines—are their possibilities strong enough to revolutionize our conventional sources of power? This new development is being watched with interest from both sides of the Atlantic and the outcome of the commercial experiments of J. F. Malone, Newcastle-on-Tyne, the inventor of the engine, will determine largely what effect it will have on engineering.

Describing the engine, *Science Service* says: One cylinder, called by the inventor the thermodynamic pile, has one end heated by hot gases from the fire to a temperature of 900 degrees Fahr. The other end is cooled continuously by a stream of cold water or air to about 70 degrees and the water in this cylinder circulates through concentric tubes, being alternately heated and cooled in its motion. The layers of heated and cooled water pass in opposite directions through the neighboring layers of the pile, which are only about one-hundredth of an inch in thickness. By this means a rapid and complete transfer of the heat of the hot gases of the furnace to the water is obtained, so that there is no difficulty in running the engine up to 250 R.P.M.

If with this new type of engine the use of boilers and condensers can be eliminated successfully, giving more power per square inch of space occupied, the influence of such revolutionary design will be more widespread than readily is imaginable.

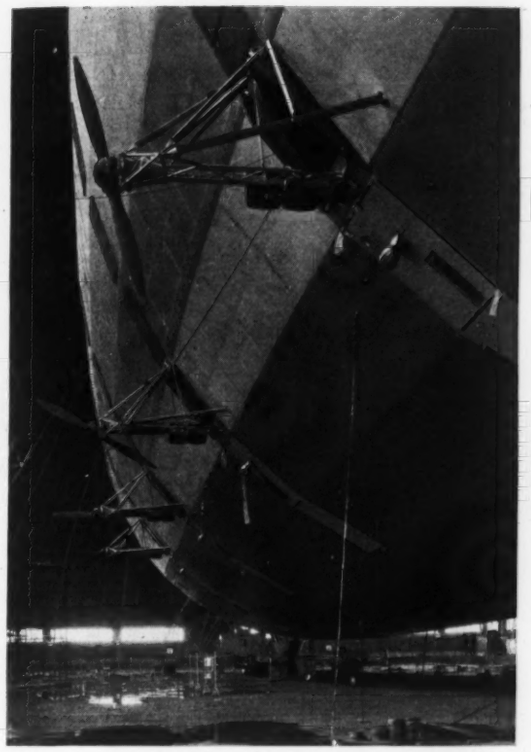


Fig. 1—Port side of ship showing propellers in position for ahead or astern thrust

TILTABLE propellers, reversing engines, water recovery system for preserving equilibrium, are features of the development of the air cruiser AKRON that engineers should be posted on. Apart from general interest, many of the ideas involved have application in the industrial field. By courtesy of Goodyear Zeppelin Corp. and Maybach Engine Co., and permission of Naval authorities, Machine Design presents the accompanying article on mechanical details of the ship.

Reversing Engines Feature U. S. S. Akron

THOUGH much has been written in recent months about the U. S. S. AKRON, comparatively little information has been published on the details of the engines installed. These engines are especially interesting in view of the fact they are of the reversing type, embodying unique design features whereby equally satisfactory operation can be obtained in either direction of rotation. The following brief account of some of the more pertinent mechanical details of the new air cruiser therefore is based largely on the features of the power plant selected.

Eight Maybach model VL-2 gasoline engines, which type is a development of the 400 horsepower Maybach engines installed in the LOS ANGELES in 1924, are utilized. Each has a sea-level rating of 560 horsepower at 1600 revolutions per minute, with compression ratio of 7 to 1. The engines are 12-cylinder, 60 degree V-design, watercooled, with aluminum pistons and crankcase, and are fitted with antifriction bearings throughout. Main and connecting rod bearings (Fig. 7) are of the roller type. In the production of the crankshaft a single piece of material

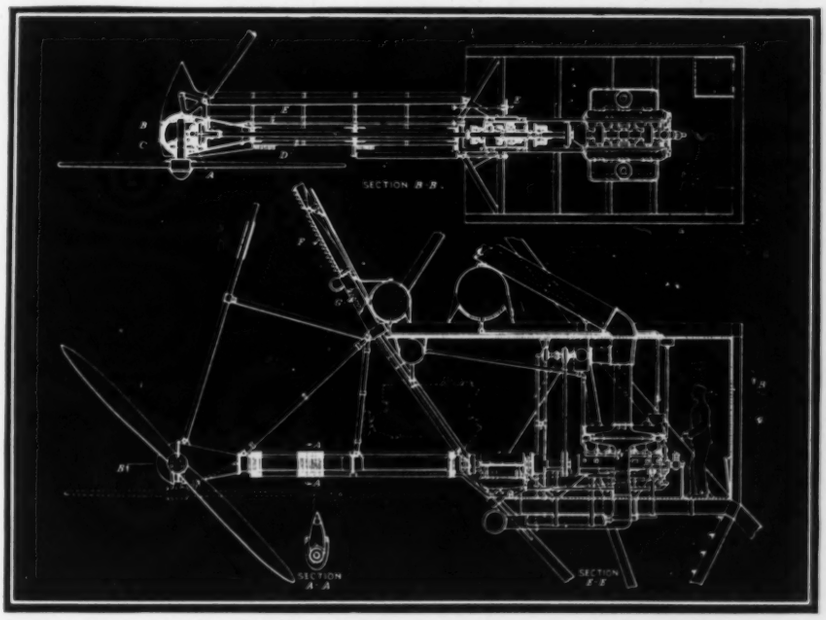


Fig. 2—Swiveling device for propellers is mounted in an inner spherical case B inside an outer case C attached rigidly to hull by braced outrigger D. Inner case can be turned through quarter of a circle by worm drive operated from engine room by the handwheel E

is employed and counterweights for balancing are fastened to the shaft by steel straps. Connecting rods are drop forged in one piece and machined all over. They are slipped over the throws of the crankshaft, in assembly, and held in position by split wedges, or bushings, and nuts. Weight of the engines is about 2500 pounds, dry, or approximately 4.5 pounds per horsepower.

Engines Are Mounted Inside Vessel

As indicated in Figs. 1 and 2, each of the eight engines is mounted inside the hull of the vessel athwartships, the propeller drive being taken through a coupling, clutch and transmission shaft passing out through the skin at the side of the ship. At the propeller end of the driveshaft is mounted a bevel pinion (*A* in Fig. 2) driving a gear at a ratio of .578, giving 925 revolutions per minute for the propeller from the full engine speed of 1600. This type of mounting permits a revolutionary idea to be embodied in the ship's construction, namely the facility for tilting the propellers through an angle of 90 degrees and thus provide for vertical as well as horizontal thrust, a feature particularly

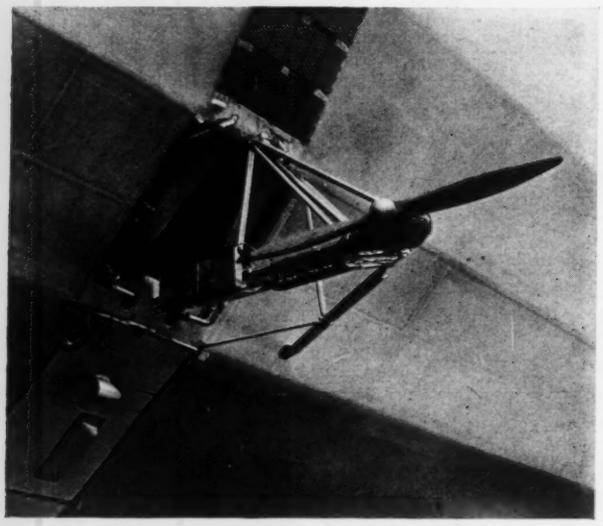


Fig. 3—Close-up view of propeller mounting. Note panels above outrigger for condensing moisture content of engine

valuable in landing the ship or in taking off. The change from horizontal to vertical thrust may be made in a few seconds. A worm gear, operated from the engine room through shafting and universal joints, is utilized to tilt the propeller through the 90 degree arc, and a jaw clutch locking device is employed to hold the tiltable section of the gear housing in either position. Giving an idea of the enormous size of these parts, each engine transmission alone weighs 1600 pounds. It is said that 97 per cent mechanical efficiency is obtainable from the gearing.

As will be appreciated, with this driving arrangement and the reversing engines, it is possible to provide not only forward and astern thrust but also upward and downward. Upward thrust of about 6000 pounds and downward of

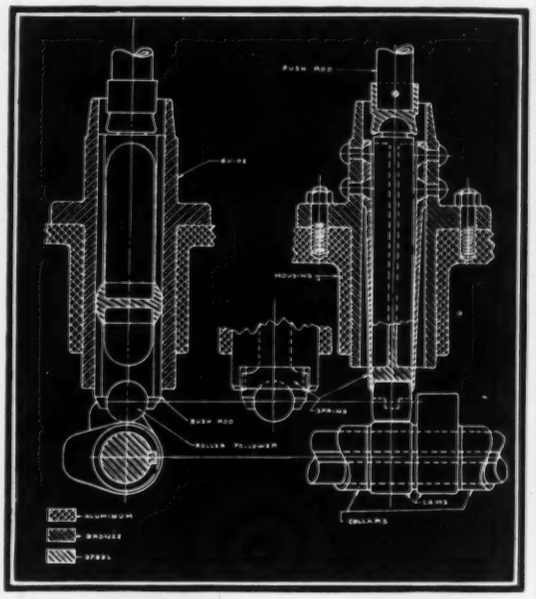


Fig. 4—Ingenious method used for preventing fouling of cams on tappet rods when camshaft is moved to bring second set of cams in operation

about 10,000 are expected to be available for assistance in handling and mooring the ship. When in normal flight it will be more economical to obtain vertical movement by inclining or pitching the ship rather than resorting to the propellers.

Engine reversibility is obtained within the engines themselves primarily by having, as shown in Fig. 6, an ahead and an astern set of cams on the camshaft, which may be shifted longitudinally to bring either set of cams into operation. Any possibility of the rise on the cams jamming against the ends of the tappet rods during shifting is obviated by the novel design depicted in Fig. 4. Each cam roller is mounted in a spring extension which deflects sideways by pressure from the cam and returns to the central position as the revolving cam rides beneath the roller in taking up its new position.

Apart from the changing of the valve timing, it is necessary that the ignition be changed when reverse engine operation is desired. Two magnetos are utilized with a double set of plugs, and the retiming is accomplished ingeniously by changing the position of the magneto drive gear on the camshaft, the magnetos being capable of operation in either direction of rotation. The magneto drive gear, shown in the lower left hand corner of Fig. 6, is provided with a helical

splined bore operating on splines in the driving sleeve on the camshaft. Thus, when this shaft is moved longitudinally to bring the reversing set of cams into operation, or vice versa, the gear moves along the splines and turns through a number of degrees at the same time to take up its new position and provide ignition at the correct setting before top dead center of pistons on the firing strokes.

A unit of the engine on which it is necessary to maintain the same direction of rotation when the engine is reversed is the double, geared type oil pump shown in Fig. 5. This also is accomplished automatically, by the use of one-way

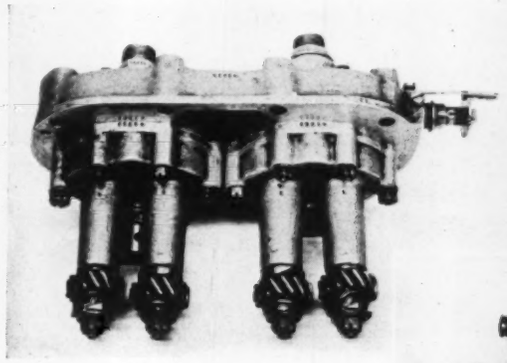


Fig. 5—Oil pump, showing reversing clutches. Fig. 6—(Right)—Camshaft and disassembled parts taken from covered end

clutches on the helical driving gears. As the driving pinion is reversed the corresponding clutches come into operation and the other two release, thus keeping both the feed and the scavenger pumps in operation as such at all times. It is possible that a somewhat similar method could have been adopted for driving the magnetos, but complications undoubtedly would arise in this case due to the necessity for providing correct ignition timing.

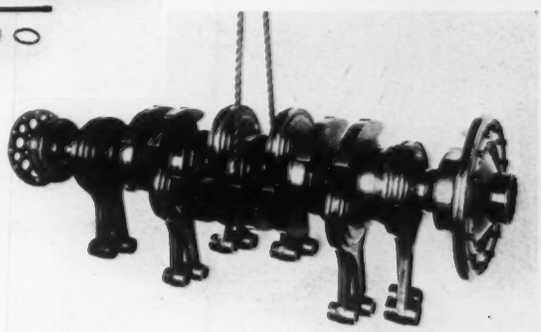
Air System Used for Starting Engines

Employment of electric starters for engines of this size being neither desirable nor practical, a compressed air starting system is used consisting of a distributor and two-stage compressor for replenishing the air. This arrangement insures positive starting even in severe weather, in either the ahead or astern direction of engine rotation. Automatic self-closing air valves are located in the cylinders of one bank, these cylinders also having safety valves which prevent overpressure in the cylinder when starting.

Engine radiators, seen in Fig. 1, are of the ordinary cored type mounted on the out-riggers which carry the transmission shafts. To give some measure of cooling when the propellers are acting vertically, supplementary cooling arrangements in the form of horizontal finned tubes are provided.

The usual method employed in the United States to preserve equilibrium of a helium-filled airship, and thereby to avoid the necessity for valving buoyant gas as fuel is consumed and the airship tends to become light, is to employ a water recovery apparatus which condenses the moisture content of the engine exhaust to water and retains the water so recovered on board the airship as ballast. Theoretically, it is possible to recover about 145 pounds of water in this manner for every 100 pounds of aviation gasoline that is burned, but this figure will vary according to several factors. The water recovery apparatus on the U. S. S. AKRON represents an effort to install the apparatus close to the hull of the airship, thereby making it somewhat of a skin type condenser, Figs. 1 and 3, and so reduce

Fig. 7—(Below)—Roller bearings are used for crankshaft and connecting rods. Crankshaft is single piece construction



its drag or resistance. The apparatus comprises five panels mounted close to the hull above each engine. Each panel consists of horizontal aluminum tubes connected by vertical headers. The flow of gas initially is upwards and the condensed water is drawn off through by-pass pipes and circulated to fabric bags throughout the airship.

Normal gasoline supply of about 124,000 pounds is stored in a total of 110 aluminum tanks mostly of 120 gallons capacity and located convenient to the engine rooms. An extensive system of piping, principally aluminum, permits fuel to be received at the bow or near amidships and to be circulated at will.

Of general interest is the fact that the AKRON is capable of accommodating 4 or 5 airplanes in a space provided in the hull at the bottom of the ship. Details of the arrangements for handling the planes in taking off and landing are not yet available.

Designing Bolts for Shock Loads

By J. I. Clower

A MACHINE member is subjected to impulsive loading when a force impinges upon it with an initial velocity. For simplicity, this discussion of loading will be confined to a load producing tensile stress only. The formulas, however, will apply as well to uniform compressive and shearing stresses.

Considering the bolt shown in Fig. 1, a member of weight W is placed at a distance h above the bolt head K. Assume that weight W is permitted to drop freely the distance h and strike the bolt head. When this static weight strikes it becomes a live load of value P, and causes the bolt to elongate an amount d. The weight in its top position possesses only potential energy; as it falls, however, this is converted into kinetic energy of an amount equal to the maximum potential energy. Also for practical purposes, the energy absorbed by the bolt when the weight W strikes it is equal to the maximum potential energy. In other words, the external work done by weight W falling the distance $h + d$ must be equal to the work absorbed by the bolt.

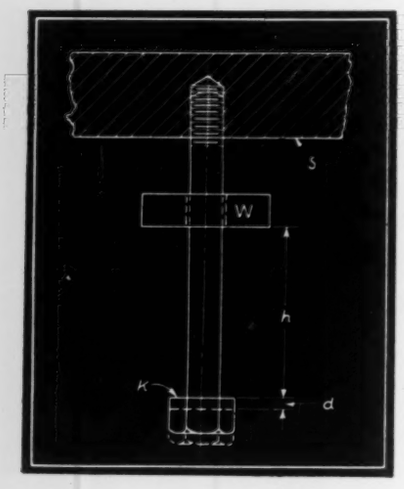


Fig. 1 — Typical loading situation with bolts or tie rods subjected to impulsive loading

Maximum potential energy

$$= W(h + d) = \frac{WV^2}{2g}$$

where V is the velocity which weight W would attain falling freely the distance $h + d$. Assuming that the elastic limit of the bolt material has not been exceeded, the internal work done, or energy absorbed by the bolt equals $\frac{1}{2} P d$, or if p represents unit induced stress of the bolt and A cross sectional area, the energy absorbed equals $\frac{1}{2} p A d$. This statement is based upon one important assumption: that the supporting member S is perfectly rigid. This assumption is hypothetical, because all materials must yield to some extent. The design is on the safe side, however, since it assumes that all the energy of the live load is absorbed by the bolt instead of being divided between the bolt and its support. Therefore $W(h + d) = \frac{1}{2} p A d$. Solving for maximum induced stress,

$$p = \frac{2W}{A}\left(\frac{h}{d} + 1\right)$$

It is evident that stress p decreases as d becomes larger; as the ratio h/d decreases. Hence, to obtain a low stress the total elongation should be as great compared to h as is consistently possible. Where other considerations will permit, the most feasible means of securing a low value for h/d is to utilize a long bolt. A 100 per cent increase in bolt length reduces stress approximately 50 per cent.

Where the length of bolt is fixed, its capacity to absorb energy may be increased by reducing the area of shank to approximately that at the root of the thread. This effects a greater elongation of the shank with consequent reduction in the h/d ratio. It should be noted that reduction of shank area increases the bolt's capacity to withstand shock loads only.

Methods of obtaining this result are: Drilling a hole through the shank; fluting the shank; and removing stock from the shank, leaving rings or collars to form a fit and keep the members in proper alignment. The first method offers a continuous bearing surface throughout its length, and gives a uniform distribution of stress. With a fluted shank sufficient bearing surface is present for proper alignment but the shank is weaker in torsion. The last method is the easiest and quickest of all to produce.

Determinations of the results of these formulas have proved that the actual gain of allowable load due to reducing the area of the shank to that of the root of the thread on a standard 1-inch bolt, 12 inches long from head to nut (1½-inch of thread) is 35 per cent.

By A. F. Clark
Editorial Representative, Machine Design

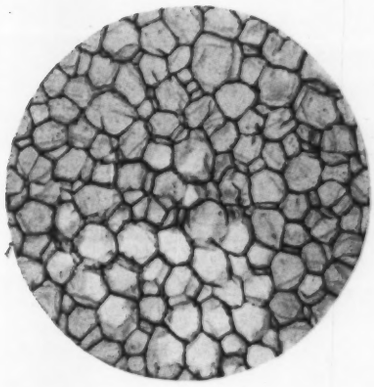


Fig. 1—Microscopic view of cork showing the material to be a mass of minute cells, each containing entrapped air

Cork Becomes Increasingly Popular as Design Material

ANTEDATING in its usefulness practically all of the materials except stone and wood that now are in general use, cork has come to be recognized as a valuable ally to the designer of machinery. This material, the spongy outer bark of the cork oak tree growing principally in Spain, Portugal and Northern Africa, has been employed since prehistoric times in applications where its compressibility, frictional resistance, resistance to liquid penetration, buoyancy and insulating properties have been major attributes. Today these properties are being adapted to scores of new uses while the chemical inertness, resilience and stability of the material are recognized as additional qualities. These properties will be outlined, and their place in solving some of the problems in design will be given in the following.

Natural cork is handicapped by the variability of the raw material, and by the flaws of structure which are uncontrollable in a natural element. To overcome this, and to control the properties more exactly, the cork is ground into small particles and recombined with various binders, producing a composition material which has all the desirable basic characteristics of the natural product without its characteristic variations.

Virtually all of the properties of cork are based on its unique cellular structure. The cells are packed closely together and enclose within thin elastic walls particles of dead air. These cells are held together by a natural bond and are so irregular in shape that each one provides upwards of 14 points of contact with contiguous cells. This construction gives cork a combination of qualities suitable for many mechanical and industrial uses. A microscopic view of the cells is shown in Fig. 1.

In each of the different compositions available, individual characteristics have been developed, produced purposely to meet particular requirements. This ability to emphasize certain qualities and eliminate others by varying the processes of manufacture is highly important. For example, the cork composition from which gaskets are made are so manufactured that they will not shrink, it being imperative that the holes in the gasket line up with the bolt holes in the metal parts. An entirely different cork composition is needed for the roll coverings on textile spinning machines. Here shrinkage is desirable. Hence, for this purpose, compositions are used which possess this particular quality. Once it has been established just which cork composition is needed for certain requirements, a uniform material of the required character can be produced.

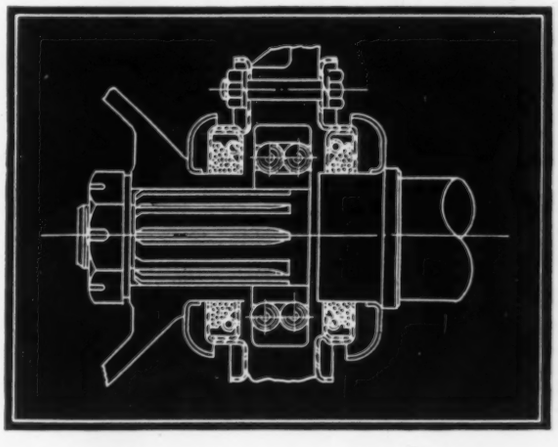


Fig. 2—Material in oil seal is pressed against shaft by a garter spring

Proteins and natural synthetic resins are the principal binders used, and the sap of the cork

itself is an important binder. In order to drive this sap out of the cork particles, they are subjected to a considerable amount of heat and at the same time compressed by hydraulic machinery. The different particles of the granulated cork thus are, in many compositions, held together simply by the sap of the material itself.

If adverse conditions attack the cork they cannot be combatted, but if they attack the binder they can be overcome by changing the binder's character. Fillers are used in some compositions, not for economy, but because the combination makes the best material for the specific use for which it is intended. Cork compositions can be fabricated into almost any size or shape. For applications where any great amount of tensile

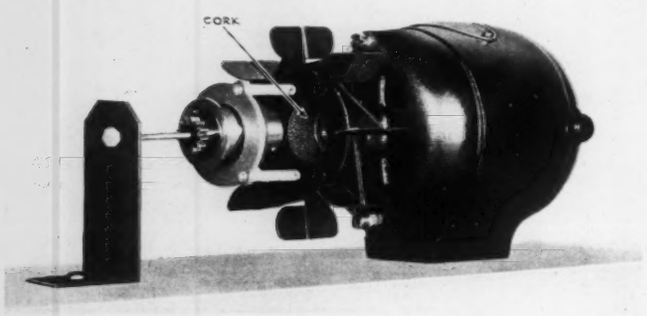


Fig. 3—Cork facing on clutch provides positive releasing or picking-up action

strength is needed, the composition is laminated with other materials.

Cork has exceptional resistance to the penetration of liquids. Except for a few highly corrosive chemicals, no liquids can work their way through its structure to any marked degree. Acids are resisted when they are in weak solutions, but the material cannot be used in contact with alkalies. No deterioration is produced by gasoline and the material is oil proof with mineral oils, a property not affected at elevated temperatures.

It can be compressed without destruction and without appreciable change of its shape while under compression except in the direction in which the force is applied. Prolonged compression, even under a heavy load, will not cause any great amount of permanent deformation. Since the material under compression is made up largely of cells filled with compressed air, the great resilience of cork is self-evident.

The combined attributes of resistance to liquid penetration, resilience, and resistance to deterioration by oil and greases makes the material ideally suited for seals or for use as a gasket material. Although it is necessary to fabricate the cork parts to closer working tolerances than is usual for other types of seals, this slight disadvantage is overcome by its effectiveness in sealing lubricants in and excluding foreign matter from bearings. Its limitation in this service is its comparatively low tensile strength, prohibiting use in certain types of bearing design. Moreover, its use is not indicated under conditions of excessive pressure nor where temperatures greatly exceed 200 degrees Fahr. Long continued heat chars the cork.

Three types of oil seals, such as the one shown in Fig. 2, are used widely. In the assembly shown, a garter spring is extended when assembled around the material, wedging the cone shape packing against the face of the outer cup, and also compressing it around the shaft. The principles employed include the shaft rotating inside the seal, the shaft and seal rotating together and the seal rotating or remaining stationary as induced by the contact of adjacent parts. In the manufacture of truck wheel groups, Fig. 4, the use of the beveled ring type of seal is favored in order to provide, when necessary, a radial spread in one direction only.

Used in Antifriction Bearings

The use of cork in antifriction bearings seems a contradiction of its frictional properties. Nevertheless, cork, when properly treated, has found wide and extremely useful application as seals and closures for ball and roller bearings. Cork is an ideal material on rotating members. In the first place it can be cut to an accurate fit and, since it neither contracts or expands, does not change dimensions in use. It allows a slow sweating of the lubricant along the member, but not through the cork, and thus retains at the surface sufficient lubricant to prevent binding. It does not take up, or allow to pass through it, any grit or dust which might cause abrasion. This type of oil seal is used extensively on the rollers controlling the moving track of tractors. However, it is only by correct grinding and screening, mixing with the proper types of binders, and compressing under definitely established pressures, that uniform cork compositions that will give this result can be produced.

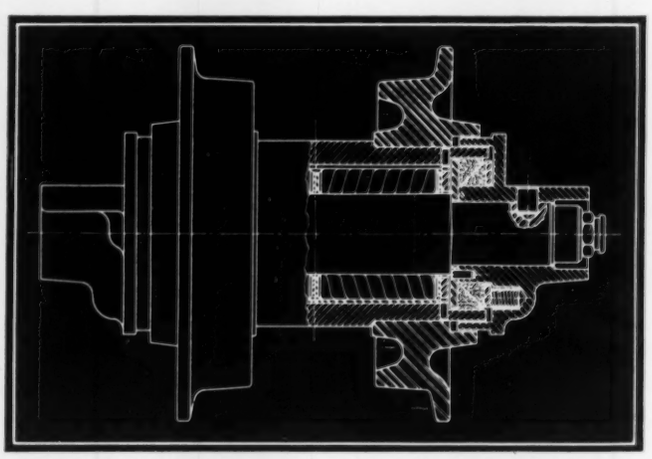


Fig. 4—Beveled ring type seal is favored in truck wheel groups

The improvement of one quality or the nullification of another often is accomplished by use of an artificial binder, as for instance asphalt and tar. In some of the compressed cork which is finely granulated and used in relation to food products a blood albumen is employed as a binder. In cork products which have to stand a considerable amount of shock, an oxidized linseed oil is used. The type of binder and size of particles may vary considerably for different applications. The amount of compression under which the compositions are made also is varied as it controls to a great extent the density of the material.

There are many uses of cork seals in automotive applications. These include: Front end seal ring where the cork is inserted inside the oil gland, and has vibration damper hub and fan pulley hub running on the inside of the cork; graphited cork is used. Rear crankshaft bearing seal which has graphited half rings inserted in the case and bearing cap; the problem here is to

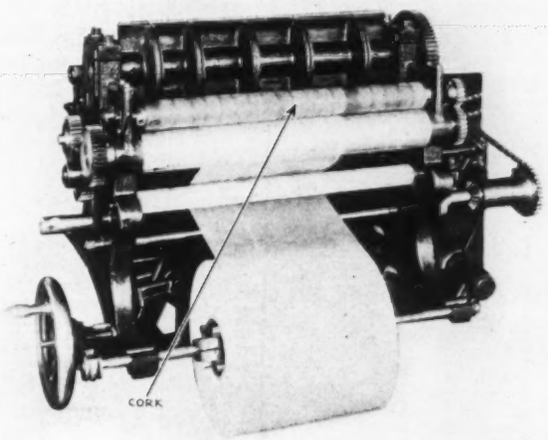


Fig. 5—Gum wrapping machine has roll covered with cork for feeding the paper

prevent the cork from turning and contracting because of the turning friction, an action that can be prevented despite the frictional qualities of the material.

The conventional type of stuffing box and packing gland has been abandoned in the sealing of many water pumps, Fig. 6. The packing gland rotates with the shaft and takes advantage of the natural property of the cork to maintain the seal effectively. A spring and follower provide take-up, eliminating the necessity of frequent adjusting or tightening. When the pump is in action, vacuum created by rotation of the impeller draws the gland and packing away from the end plate and relieves frictional contact. When the pump stops, the 5-pound spring pushes the cork back against the end plate effecting a seal.

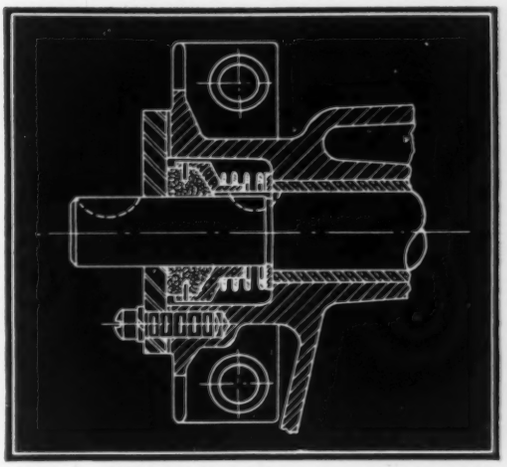


Fig. 6—Cork seals on water pumps withstand severe usage

Another water seal also has been used effectively on the propeller shaft of outboard motors. Here it performs the reverse operation of preventing water from entering the equipment, rather than preventing its escape, while it also keeps lubricant in.

Both in its natural state and in compositions, the coefficient of friction of cork is decidedly greater than that of rubber, leather and other materials often used for frictional purposes. It is unique that this quality is retained to a considerable degree even when the material is wet or coated with oil and grease. This quality is a property of its air cell structure. No matter how cork is cut, shaped, or combined its surface presents a myriad of tiny fractured air cells which grip like vacuum cups. Thus cork does not wear smooth or glaze with use and so lose its frictional power.

Provides Positive Power Transmission

For the transmission of power in driving, drawing, or braking, few materials are the equal of cork for positive and dependable action. Because of its firm and positive gripping action, it should not be used in clutches or similar applications where any great amount of intentional slippage is desired. The clutch on the motor of the projection machine, Fig. 3, is an example of the use of cork where the releasing and picking up action must be positive and immediate. In a gum wrapping machine, Fig. 5, this frictional quality is employed extensively. The upper one of the three rolls is covered with cork. It feeds and measures the paper.

Every engineer is familiar with cork as heat insulation and machinery isolation. Here are two of the major uses of quantities of the material and with the ever growing demand for reduced vibration, the isolation of machines is assuming an important place in industrial applications.

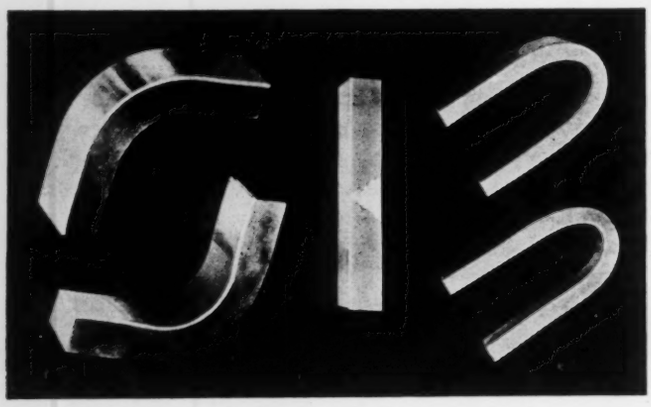
Cork as a material has a remarkable capacity

for retaining its initial properties practically unimpaired under all conditions where its use is recognized. Unlike most materials it is not subject to progressive deterioration and, hence, does not become less efficient as time goes on. Generally speaking, cork is not affected to any practical degree by temperature, humidity, and atmospheric conditions. Severe service conditions and the demand for long life with constant efficiency are no barrier to its use provided, of course, it is used in applications for which it is fundamentally suited by its extensive properties.

For assistance in the preparation of this article, the co-operation of the following companies is gratefully acknowledged: Allis Chalmers Mfg. Co., Springfield, Ill.; Armstrong Cork Co., Lancaster, Pa.; Crown Cork & Seal Co., Baltimore, Md.; Korfund Co. Inc., Long Island City, N. Y.; Lycoming Mfg. Co., Williamsport, Pa.; Universal Oil-Seal Co. Inc., Pontiac, Mich.; and Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Composite Steel Resists Corrosive Forces

COMBINING the corrosion resisting properties of the high-chromium, high-nickel alloy steels with the comparatively low cost of mild steel, a new composite steel has been introduced that is especially applicable for parts, or containers, exposed to corrosive forces. The material, known as "Plykrome," has a thin coating of the alloy welded to a larger section of the less expensive material. The alloy completely protects the material beneath it from any destructive agent to which it might be exposed.



Cold bend tests of composite steel showing perfect condition of metal after 90 and 180 degree bends with alloy on inner and outer faces. In the center is shown a typical fabrication weld

The ratio of alloy thickness to that of the sheet or plate can be anything that is desired. Industrial Welded Alloys Inc., New York, manufacturers of the material, point out that 0.010-inch thick steel plate with an alloy ply of 0.00125-inch has been rolled successfully. Present practice is to recommend a ratio of approximately 1:15 as presenting the opportunity for best economy.

In the manufacture of this new material a plate of the corrosion-resisting alloy of predetermined thickness is welded by a special process to the steel slab, billet or bloom before rolling. It is then rolled in accordance with usual mill practice into plates, bars, sheets, etc. The alloy surface then is sandblasted, pickled or polished, depending upon the use for which it is intended. Equipment fabrication is done exclusively at the manufacturer's plant, following the special alloy arc welding process developed by the company in its handling of chrome-nickel steels, and the recognized practice for welding the mild steel backing.

Ultimate Strength Is Increased

The composite steel has an ultimate strength that is considerably greater in relation to mild steel than the proportionate thickness of alloy would indicate. One series of recent tests disclosed that, while the total thickness of the plate was increased 7 per cent by applying a veneer of alloy, the ultimate strength was increased 25 per cent. Furthermore, since only a small percentage of the total metal thickness is alloy steel, the composite sheet or plate can be handled by the methods common to the fabrication of ordinary steel, as, for example, cutting with an acetylene torch, cold bending, and the like.

The material has been produced with its corrosion-resisting alloy component of any desired analysis—14-18 or 28-30 per cent chromium, 18-8 or 25-20 per cent chrome nickel, or nichrome, hasteloy, and others.

Physical tests have disclosed that the metal can be handled, bent, drawn, spun or flanged without cracking or parting the alloy from the steel. In an oxidation test, made primarily to measure the resistance of the relatively thin alloy veneer to high temperatures, the mild steel backing oxidized and flaked away, while the alloy had no oxidation loss, no blisters, surface cracks or parting of the weld bond.

Bringing Gearing Formulas Up To Date

By Geo. H. Middleton

NO LONGER are old strength formulas for gear designing adequate for present day conditions, since so many other factors must be taken into account, such as number of teeth in contact, velocity of sliding, amount and characteristics of load supporting areas, etc. General conditions of the contact of involute gear teeth were studied in the August issue of MACHINE DESIGN and the conditions of interference of rack and pinion were investigated mathematically. The method of determining its occurrence, means of avoiding it and calculations for contact of rack and pinion under the various conditions were demonstrated in the previous article.

The following data, used in the previous article, again will be used in the derivation of the formulas. It is repeated for convenience in following the developments.

C and O = centers of wheel and pinion respectively
R and r = pitch radii of wheel and pinion respectively
N and n = numbers of teeth of wheel and pinion respectively
T and t = points of tangency of line of action on wheel and pinion base circles
A = point of contact commencement
L = point of contact termination
P = pitch point
$A/D.P.$, $a/D.P.$ = addenda of wheel and pinion respectively
β = pressure angle
x = rack tooth correction height
h = corrected gear addendum height
1 represents addendum circles
2 represents pitch circles
3 represents base circles
4 represents working depth circles

The next study will be of cases of unequal gears, with and without interference, in each of the four aspects called for by the questions in the following. These two cases have been designated (iii) and (iv).

(a) *Does interference occur?*

As in the case with the rack, the interference commences when the point of tangency t falls on the addendum circle of the mating gear. If inside of the addendum circle the trochoid developed in the pinion undercuts the tooth and causes loss of contact.

Referring to Fig. 4, A coincides with t and $Pt = PA$.

Now

$$Pt = r \sin \beta$$

$$PA = TA - TP$$

$$TA = \sqrt{\left(R + \frac{A}{D.P.}\right)^2 - (R \cos \beta)^2}$$

$$= \sqrt{R^2 + \frac{2AR}{D.P.} + \frac{A^2}{D.P.^2} - R^2 \cos^2 \beta}$$

$$= \sqrt{R^2 \sin^2 \beta + \frac{2AR}{D.P.} + \frac{A^2}{D.P.^2}}$$

and

$$PA = \sqrt{R^2 \sin^2 \beta + \frac{2AR}{D.P.} + \frac{A^2}{D.P.^2}} - R \sin \beta = Pt = r \sin \beta$$

In terms of N and n

$$\frac{n}{2D.P.} \sin \beta = \frac{1}{D.P.} \sqrt{\frac{N^2}{4} \sin^2 \beta + NA + A^2} - \frac{N}{2D.P.} \sin \beta$$

or

$$n = \frac{2}{\sin \beta} \sqrt{\frac{N^2}{4} \sin^2 \beta + NA + A^2} - N \quad \text{.....(8)}$$

For the special case of B & S teeth

$$n = 8 \sqrt{\frac{N^2}{64} + N + 1} - N \quad \text{.....(8a)}$$

The chart, Fig. 5, gives these values as plotted, and, knowing the numbers of teeth of B & S particulars, it can be found whether or not interference is present from the line showing the interference values.

(b) *How much must addendum or pressure angle be modified to avoid interference?*

Should interference occur, the addendum of the mating gear must be reduced to a radial

MODERN conditions have imposed on the gear designer many factors with which the old strength formulas are unable to cope. This investigation, the second of a two-part series, studies in the light of latest developments the cases of unequal gears, with and without interference.

amount, h, which will just allow the addendum circle to pass through the tangency point t.

Then

$$Ct = \sqrt{CT^2 + (TP + Pt)^2}$$

$$= \sqrt{R^2 \cos^2\beta + (R \sin\beta + r \sin\beta)^2}$$

$$= \sqrt{R^2 \cos^2\beta + R^2 \sin^2\beta + 2Rr \sin^2\beta + r^2 \sin^2\beta}$$

$$= \sqrt{R^2 + (2Rr + r^2) \sin^2\beta}$$

and

$$h = Ct - R$$

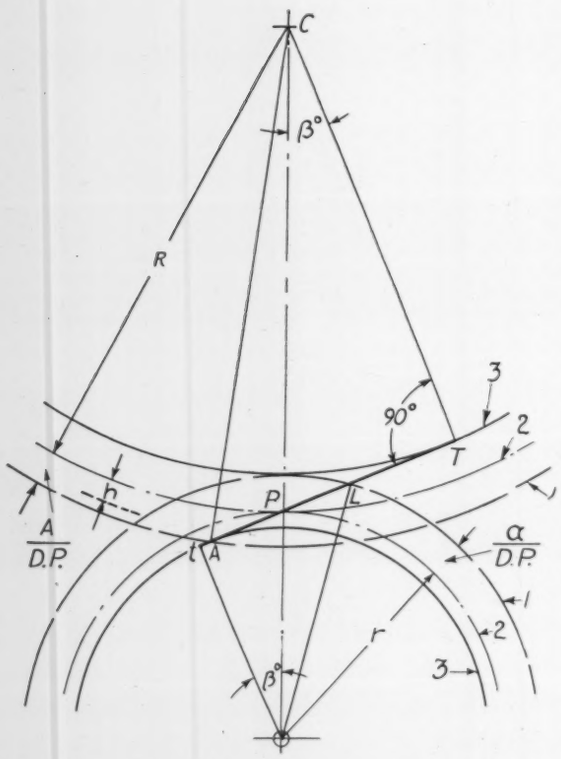


Fig. 4—Interference commences when point of tangency t falls on addendum circle of mating gear

In terms of numbers of teeth

$$h = \frac{1}{2D.P.}\left(\sqrt{N^2 + (2Nn + n^2) \sin^2\beta} - N\right) \quad \text{.....(9)}$$

For B & S gears

$$h = \frac{1}{2D.P.}\left(\sqrt{N^2 + \frac{Nn}{8} + \frac{n^2}{16}} - N\right) \quad \text{.....(9a)}$$

If it is desired to increase the pressure angle and keep the standard addendum the formulas can be developed as follows:

$$Ct = R + \frac{A}{D.P.} = \sqrt{R^2 + (2Rr + r^2) \sin^2\beta} \quad \text{(from above)}$$

therefore

$$\frac{1}{2D.P.}(N + 2A) = \frac{1}{2D.P.}\sqrt{N^2 + (2Nn + n^2) \sin^2\beta}$$

Squaring,

$$N^2 + 4NA + 4A^2 = N^2 + (2Nn + n^2) \sin^2\beta$$

and

$$\sin\beta = 2\sqrt{\frac{NA + A^2}{2Nn + n^2}} \quad \text{.....(10)}$$

An empirical rule which gives good results on spur gears where the large gear has upwards of 40 teeth is to enlarge the pinion an amount equal to about 4/5 of the full rack enlargement as given in the B & S rule quoted in the foregoing, and thus reduce the gear by an equal amount. The lengthened addendum thus obtained gives stronger pinion teeth, and avoids change of pressure angle or tooth depth. It is as follows:

$$\text{Outside diameter of pinion} = \frac{0.96n + 1}{D.P.} + 2 \times \text{addendum}$$

Correction starts at 25 teeth and the rule is quite good for B & S teeth.

Figs. 6 and 7 show comparative tooth shapes developed on standard diameter and on a diameter enlarged by the formula. The better shape, greater strength and longer line of action of the corrected tooth are very noticeable, and indicate the advisability of eliminating interference by one of the proposed methods.

(c) *What is the length of contact line?*

First, it can be seen that the contact line, without interference, is made up of the addendum contact of gear and pinion together, that is $LP + PA$. From the discussion of the interference limit in formula (8), it is found that

$$PA = \frac{1}{D.P.}\left(\sqrt{\frac{N^2}{4}\sin^2\beta + NA + A^2} - \frac{N}{2}\sin\beta\right)$$

and

$$LP = \frac{1}{D.P.}\left(\sqrt{\frac{n^2}{4}\sin^2\beta + na + a^2} - \frac{n}{2}\sin\beta\right)$$

Therefore, contact without interference

$$AL = \frac{1}{D.P.}\left(\sqrt{\frac{N^2}{4}\sin^2\beta + NA + A^2} + \sqrt{\frac{n^2}{4}\sin^2\beta + na + a^2} - \frac{N + n}{2}\sin\beta\right) \quad (11)$$

For B & S values

$$AL = \frac{1}{D.P.}\left(\sqrt{\frac{N^2}{64} + N + 1} + \sqrt{\frac{n^2}{64} + n + 1} - \frac{N + n}{8}\right) \quad (11a)$$

Now, if interference is present the point t terminates the contact and hence contact is independent of the mating gear. Actually, if the interference is not corrected, the undercut will take away some of the contact, which would be possible mathematically, and the calculated values would be incorrect.

Assuming injurious contact taken care of by

modifying the gear addendum, however, the length of contact line is obtained as follows:

Total contact $= Lt$

$$= \sqrt{\left(r + \frac{a}{D.P.}\right)^2 - (r\cos\beta)^2}$$

$$= \sqrt{r^2 + \frac{2ar}{D.P.} + \frac{a^2}{D.P.^2} - r^2\cos^2\beta}$$

$$= \sqrt{r^2\sin^2\beta + \frac{2ar}{D.P.} + \frac{a^2}{D.P.^2}}$$

In terms of numbers of teeth

$$= \frac{1}{D.P.}\sqrt{\frac{n^2}{4}\sin^2\beta + na + a^2} \quad \text{.....(12)}$$

For B & S teeth

$$= \frac{1}{D.P.}\sqrt{\frac{n^2}{64} + n + 1} \quad \text{.....(12a)}$$

(d) *How many teeth in contact?*

As in the case of rack contact, the actual numbers of teeth in contact may be determined readily by dividing the lengths obtained in formulas (11) and (11a), (12) and (12a), by the values of the base circle pitch, formulas (7) and (7a), which are

$$B.C.P. = \frac{n}{D.P.} \times \cos\beta \times \frac{\pi}{n}$$

$$= \frac{\pi}{D.P.} \times \cos\beta \quad \text{.....(7)}$$

For B & S standard

$$B.C.P. = \frac{3.042''}{D.P.} \quad \text{.....(7a)}$$

Cases (v) and (vi) of equal gears are merely a special modification of the cases of unequal gears dealt with in the foregoing.

(a) *Does interference occur?*

By taking formulas (8) and (8a), and making N equal n,

$$N = \frac{2}{\sin\beta}\sqrt{\frac{N^2}{4}\sin^2\beta + NA + A^2} - N$$

$$N^2\sin^2\beta = \frac{N^2}{4}\sin^2\beta + NA + A^2$$

or

$$0 = 3N^2\sin^2\beta - 4NA - 4A^2$$

Solving this,

$$N = \frac{4A \pm \sqrt{16A^2 + 48A^2\sin^2\beta}}{6\sin^2\beta} \quad \text{.....(13)}$$

For B & S values

$$N = \frac{32}{3} \pm \frac{8}{3}\sqrt{19}$$

$$= \frac{8}{3}\left(4 \pm \sqrt{19}\right) = 22.3 \text{ teeth} \quad \text{.....(13a)}$$

This shows that with equal gears above 22 teeth there need be no fear of interference in the B & S system.

(b) *How much should addendum or pressure angle be corrected to avoid interference?*

Taking formulas (9) and (9a) for addendum correction,

$$h = \frac{1}{2D.P.}\left(\sqrt{N^2 + (2N + N^2)\sin^2\beta} - N\right)$$

$$= \frac{N}{2D.P.}\left(\sqrt{1 + 3\sin^2\beta} - 1\right) \quad \text{.....(14)}$$

For B & S values

$$h = \frac{N}{2D.P.}\left(\sqrt{1 + \frac{3}{16}} - 1\right) = \frac{0.0448N}{D.P.} \quad \text{.....(14a)}$$

Pressure angle correction will be obtained by substituting $N = n$ in formula (10) which becomes

$$\sin\beta = 2\sqrt{\frac{AN + A^2}{2N^2 + N^2}}$$

$$= \frac{2}{N}\sqrt{\frac{AN + A^2}{3}} \quad \text{.....(15)}$$

(c) *What is length of contact line?*

Again substituting in formulas (11) and

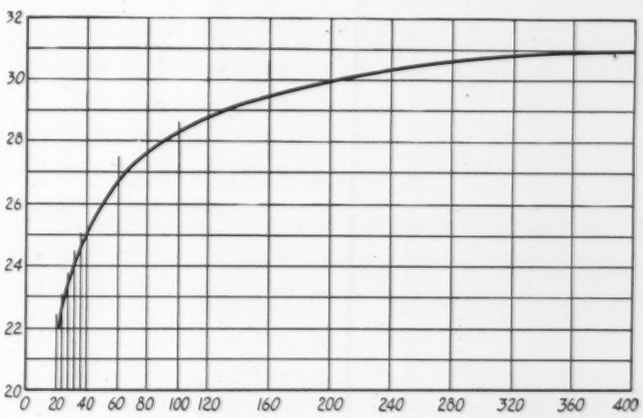


Fig. 5—Interference line for B & S standards

(11a) it is found that without interference the contact length

$$= \frac{2}{D.P.}\left(\sqrt{\frac{N^2}{4}\sin^2\beta + NA + A^2} - \frac{N}{2}\sin\beta\right) \quad \text{.....(16)}$$

For B & S values, contact length

$$= \frac{2}{D.P.}\left(\sqrt{\frac{N^2}{64} + N + 1} - \frac{N}{8}\right) \quad \text{.....(16a)}$$

If interference is present, it is obvious that the length of contact line is entirely controlled by the points of tangency t at each end of the

line of action, and the maximum possible length will be

$$2 \times Pt = 2 \times R \sin \beta$$

$$= \frac{N}{D.P.} \sin \beta \quad \text{.....(17)}$$

For B & S gears this evaluates to

$$\frac{N}{4D.P.} \quad \text{.....(17a)}$$

(d) *How many teeth in contact?*

The values of contact in numbers of teeth again are obtained by dividing lengths obtained in formulas (16) and (16a) by the base circle pitch of formulas (7) or (7a).

Simple Formula Is Developed

For the special case of equal gears with interference, the number of teeth in contact evaluates to a simple formula

$$n_c = \frac{N \sin \beta}{D.P.} \div \frac{\pi}{D.P.} \times \text{ccs } \beta$$

$$= \frac{N}{\pi} \tan \beta \quad \text{.....(18)}$$

For B & S system

$$= \frac{N}{12.167} = 0.0822\ N \quad \text{.....(18a)}$$

The formulas given in the foregoing are strictly applicable to only generated gears of true involute form; and should be used with discrimination for gears cut by rotary form cutters or templet copied gears, which are only approximately involute. Form cutters on certain sizes have modified forms to take care of the undercut which generating tends to develop, and further are only correct for one particular gear of the range they cover. Hence a mathematical agreement with the pure involute formulas derived in this article cannot be expected.

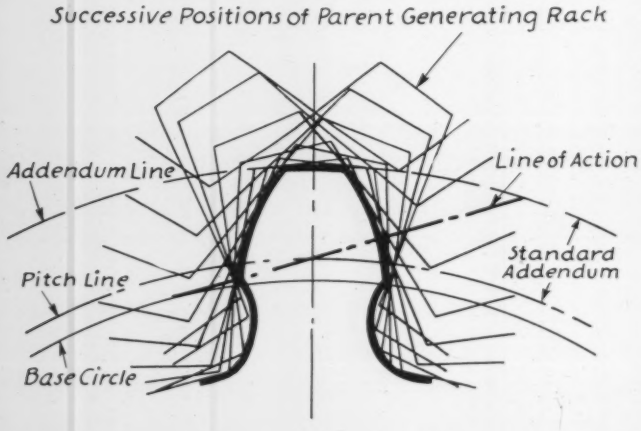


Fig. 6—Generation of tooth contour of a 12-toothed pinion B. & S. standard shape

The most important solutions obtained on this investigation and formulas corresponding, are as follows:

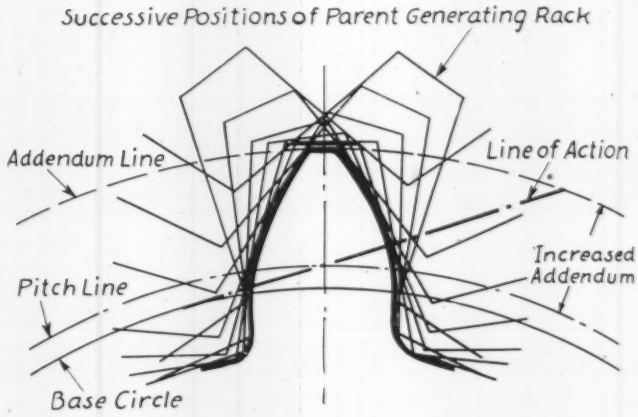


Fig. 7—Suggestion for generation of improved tooth contour for 12-toothed pinion

	Formulas General	&	B & S
Tests for Interference:			
(1) Rack and pinion limits	1	&	1a
(2) Unequal gears limits	8		8a
(3) Equal gears limits	13		13a
Addendum Correction for Interference:			
(1) Rack and pinion	2		2a
(2) Unequal gears	9		9a
(3) Equal gears	14		14a
Pressure Angle Correction for Interference:			
(1) Rack and pinion	3		....
(2) Unequal gears	10		....
(3) Equal gears	15		....
Length of Contact Line:			
(1) Rack and pinion (no interference)	4		4a
(2) Rack and pinion (with interference)	5		5a
(3) Maximum possible contact	6		6a
(4) Unequal gears (no interference)	11		11a
(5) Unequal gears (with interference)	12		12a
(6) Equal gears (no interference)	16		16a
(7) Equal gears (with interference)	17		17a
Base circle pitch	7		7a
Total number of points contact = length of contact line divided by base circle pitch			
Special case of equal gears with interference	18		18a

From these data, charts can be made for any system and the somewhat tedious calculations much reduced.

THE SOVIET UNION during 1930 was the largest buyer of American agricultural machinery in the world and held second place in imports of American industrial machinery according to the Amtorg Trading Corp., New York, who handles the bulk of the purchases. During the current year, which is the third of the operation of the five-year plan, over 3½ billion dollars will be invested in Soviet industrial construction.

Vacuum Principle Believed Failure in Harvesting Machine

IS it possible to develop a satisfactory, salable cotton picking machine? Here is a problem engineers have been struggling with for scores of years, some of the early attempts being depicted on page 53. Wonderful opportunities for outstanding inventive genius are presented in designing this type of machine, with necessity for deep consideration of the numerous pitfalls—of interest also to designers in other fields—discussed in Prof. Scoates' article. The author is head of the agricultural engineering department, Agricultural and Mechanical College of Texas, College Station, Texas.

By D. Scoates

MECHANICAL harvesting of cotton has been an exceedingly difficult problem to solve. It is a hard problem at best but what has held back the development more than any other one thing is modern practice in picking. There is a great deal of prejudice against picking cotton by machinery, and, also, it is hard to improve upon the hand method used. Practically every person who starts to think about harvesting cottcn mechanically, if they know anything about the cotton plant, or have heard anything about it, or have seen it raised, immediately think of harvesting it by the use of a suction tube. They know that a vacuum cleaner will pick up dirt and that cotton can be picked cut of the boll in much the same way (like the hand does it), so why not put the two together? That idea is being suggested to this day by novices working on the problem.

Worker's Speed Is Reduced

Just what is the trouble with the vacuum principle? Up to date all the machines that use it have a long tube at the end of which a hand worker is employed to direct the tube to the boll of cotton. The hand worker must use one hand to handle the tube and the other hand on the cotton plant. Now a good hand cotton picker uses both hands to pick cotton so that designers really have slowed up the hand picker 50 per cent by giving him the vacuum tube. It took a long time to find this out, but is the basic reason why the vacuum principle does not get anywhere.

There are possibilities in the use of vacuum principle in the picking of cotton if it can be applied to the cotton plant mechanically. Few attempts have been made along that line. It is entirely possible that something like this could be worked out, although there are troubles ahead for anyone who tries to do it, for a vacuum suction nozzle does not discriminate in what it picks up. It will take a leaf or any other trash as quickly as it will take cotton out of the boll. That is a decided handicap for the vacuum principle because the problem that is holding back the final solution of the mechanical harvesting of cotton is trash. Many machines will pick the cotton but they collect too much trash in the form of leaves, bolls, stems and branches of the cotton plant. There is also some shale, which is

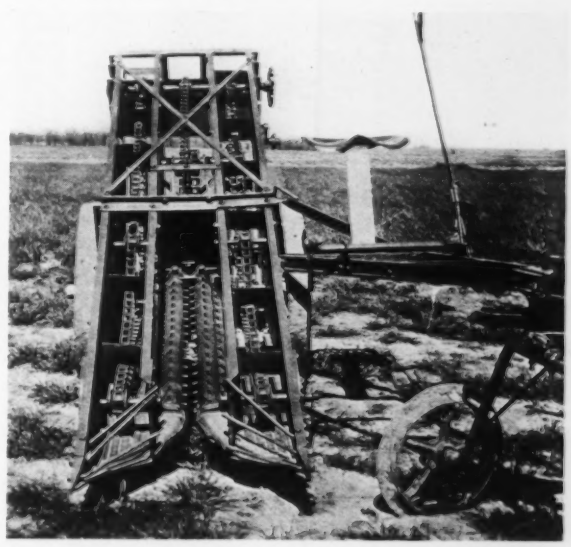


Fig. 1—Spikes are used in rolls of this stripper to knock bolls from the plants

like a small leaf and is on the bottom side of the boll, that gives a good deal of trouble.

It might be said at this point that there are three schools of thought on how this problem of mechanical harvesting of cotton is to be solved. One thinks it is best to pick all the cotton out of the boll in the field, the same as hand labor does it today. Another believes it advisable to go into the field and strip the bolls (which hold the cotton) off the plant, and then mechanically clean the cotton out of the bolls with a machine. Still another group feels that the final answer to the problem will be a combination of the two, the picking of the cotton out of the bolls to come first and the stripping to come as a cleaning up or salvaging proposition.

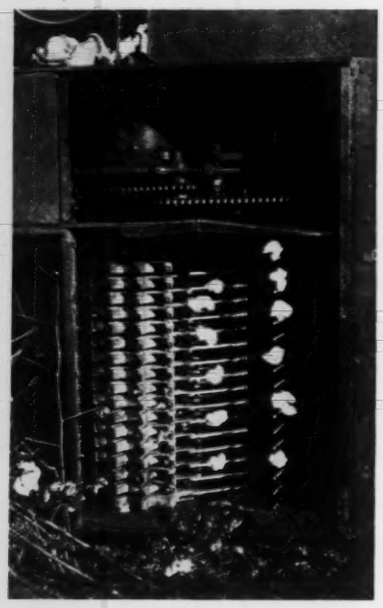


Fig. 2 — Detail of the spindles showing cotton as taken from the plant ready to be removed to the cleaning or storage compartment

The vacuum type machine, of course, falls into the first group. There are, however, several other methods of picking cotton out of the boll in the field. All the other machines that do this sort of thing are large, clumsy and complicated. They are, therefore, expensive, and in most cases subject to serious damage when they encounter obstacles such as rocks, stumps, etc. So the design and development of this type of machine is costly and if it is the final solution to the problem it will entail considerable initial investment as well as expense to operate.

Fingers Pick Cotton from the Boll

The machines of the picking type use some form of finger to pick the cotton from the boll. These fingers are studded in large drums, and in practically all cases the drums are in pairs with their axles vertical. They usually revolve in directions opposite to which the machine is moving and at about the same speed as the machine moves forward. These picking fingers revolve when they come in contact with the cotton plant and in this way entwine themselves into the cotton and pull it from the boll. The cotton is stripped off the fingers by various means when the fingers get out of contact with the cotton plant.

Electricity May Aid Picking

Some research workers believe here is an opportunity to use electricity with these spindles as an aid to picking. Research work along this line has resulted favorably. If this principle can be developed it is impossible to predict how far and wide the application can be used, in not only harvesting cotton but in the machining of it afterwards.

The Meyercord machine uses a different type of finger from those given in the foregoing. This finger consists of two prongs which may be considered miniature fingers. They revolve and engage in the cotton plant and pull the cotton from the boll. One of the decided advantages of this type is that there is no trouble in getting the cotton off the finger because when they are reversed they drop the cotton readily. Mr. Meyercord, in his machine, uses four vertical drums in place of two. The fingers are not long, hence they do not project far into the cotton plant. This trouble is overcome by folding the cotton plant into a small space when it passes through the machine. Friction drive is used for the fingers, to eliminate any possibility of oil or grease getting into the cotton. Oil in the cotton would increase the fire hazard; and if it should become generally known that mechanically harvested cotton was apt to have oil in it, this would cause the insurance companies to run up their premiums on this type of cotton. The result would be that the penalty would work materially against the development of mechanical cotton picking.

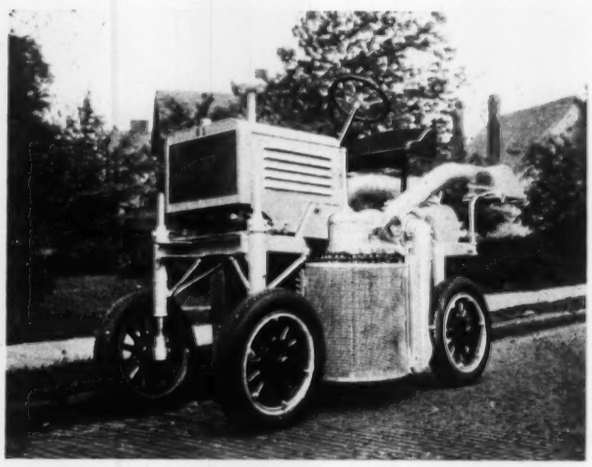


Fig. 3—Harvesting machine that employs spindle principle for removing the cotton

There are two different methods in general

use as a basis for building picking machines. One is to build them on a chassis which is self propelled, such as an automobile or truck chassis, and the other is to build them so that they can be pulled and operated by a tractor. It is interesting to note that the implement companies in the development of their machines have designed them for pulling and operating by tractor, while outside companies who are developing cotton pickers seem to prefer the self-propelled type.

The most important difficulties that confront the picking machine today are the manufacture of a simple machine, getting its cost down as low as possible, the perfection of the device for cleaning the cotton, and the handling of all sizes and shapes of cotton plants.

The gin people have been doing considerable work in perfecting methods of cleaning cotton due to the fact that they had it forced on them in West Texas and Oklahoma. When cotton was cheap a number of years ago, the farmers in this territory stripped their cotton by hand or by the use of crude, home-made devices. By stripping is meant the pulling of the bolls of cotton off the plant. All this was done after frost when the leaves had left the plant so there were not many leaves in the cotton. The bolly cotton was sent in this shape to the gin where it could be cleaned in an excellent manner.

Must Combat Green Leaf Problem

The gins have not done anything with the green leaf, however, because they have not had to combat this problem. They do not seem to be able to do a very good job with the dry leaf. Here is an opportunity for someone to do some excellent fundamental research on the cleaning of cotton. The problem is to machine the cotton as little as possible and yet remove all types of trash that might be present.

Stripping of cotton mechanically came into vogue, as stated, in West Texas by the use of home-made devices which consisted principally of finger type machines. Since this development John Deere Plow Co. has brought out a stripper, Fig. 1, which works well. There are also a number of other strippers on the market. These are all used on West Texas cotton after frost has hit the plant and the wind has blown the leaves off. The Deere machine consists of two rolls with small spikes in them. When these rolls revolve they knock the bolls off the plant and throw them into the elevators at the side of the rolls which carry the cotton to the back of the machine where a cleaner separates the bolls from the cotton and throws the bolls out on the ground.

The development of a stripping machine at A. & M. College of Texas by the agricultural engineers there, Fig. 4, is along this line except that it is used to strip the cotton from the plant while the leaves are still green. A stripper such as the Deere can be used only in limited areas, such as West Texas. If the stripper is to be used in the rest of the cotton belt it must work in the presence of green leaves. In an attempt to work this out two rubber rolls were placed about $\frac{5}{8}$-inch apart and on a 45 degree angle

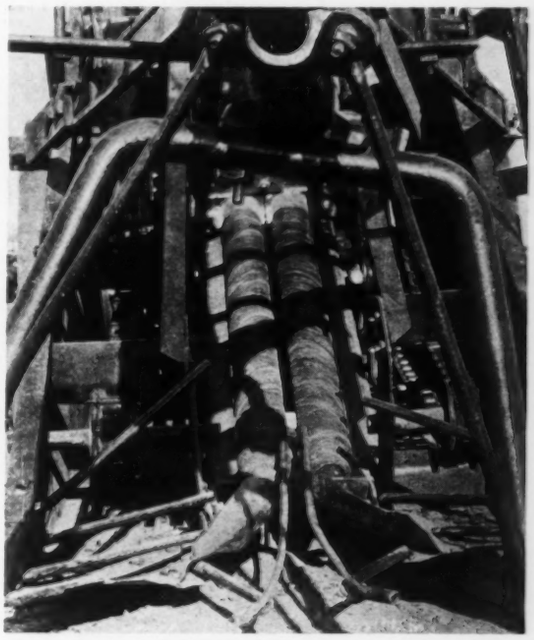


Fig. 4—Rubber rolls are used on machine that strips cotton from plant while leaves are green

with the horizontal. One of these rolls was fixed while the other was free to move laterally. They both revolved with a rotation away from the cotton plant. The rolls were made of rubber. Peripheral speed of the rolls is approximately the same as the forward speed of the machine. This machine has been used in cotton with green leaves and it has been found to give excellent results. In some conditions it gets over 90 per cent of the cotton and only a small percentage of the green leaves.

Need Method of Removing Leaves

This harvesting method does, however, get some green leaves so the present problem in the development of the machine, as with the pickers, is to develop a method of removing the green leaves from the cotton. It is felt that this must be done as soon after the cotton is picked as possible. In any case it must be done before the cotton leaves the machine.

The solution of this problem of building a machine to harvest cotton mechanically has made definite progress during the past few years and while it cannot be said at this time just which type of machine will work out to be the best, yet in all probability some of the machines that now are being developed will do the job.

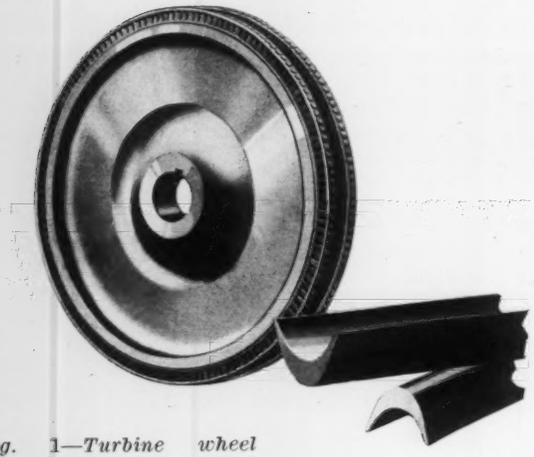


Fig. 1—Turbine wheel blades produced from cold drawn shapes

Cold Drawn Shapes a Offer Economy i

By H. B. Veith

DESIGN of a machine is successful only when it incorporates a full understanding of high production requirements and rigid demands for economy, besides the necessity for satisfactory performance of the finished unit. Before the final layout the engineer responsible for the design must have studied each particular machine detail giving careful consideration to available types of materials which might be used for it.

Special shapes, both cold drawn and extruded, fall into this category as materials to which designers of machinery are turning to meet the requirements of efficiency and serviceability. For many machine parts it is desirable that the application of special shapes be considered before the parts are designed for production as castings or forgings. It, therefore, is the purpose of this article to describe some of the pertinent characteristics and possibilities of special shapes.

Practically Any Shape Is Obtainable

Of the thousands of opportunities for application that exist, only a small portion of this field has been reached thus far. In the case of cold drawing, bars formerly were produced only in a limited number of shapes, namely, rounds, flats, squares and hexagons. If machine parts of special shape were required it was necessary to machine certain portions to obtain the desired section. This is illustrated clearly in Fig. 5, which shows two cold drawn shapes, formerly machined from bars, the dotted lines indicating the outline of the stock. Now it is possible to obtain practically any shape. This offers obvious advantages, particularly where the quantity of parts required warrants the production of the necessary dies.

While the cold drawn and extrusion processes are dissimilar, it is noteworthy that the products of both methods have properties in common. In both cases tensile strength is increased and accuracy is effected to the extent that machining in many instances is eliminated. Because of the difference in the nature of the processes it is advisable to treat them separately in the following.

By cold drawing, bars are formed into standard or irregular (special) shapes of accurate dimensions, refining the physical properties of the metal and rendering the surface extremely smooth. Ordinary hot rolled bars are pickled to remove the scale, after which they are drawn through dies and straightened. A shape of desired size is not produced necessarily with one pass through a die. It may take a number of drawing operations to turn out the finished product. Considerable mechanical hardness is imparted to the material by drawing and, therefore, it must be annealed between subsequent drafts.

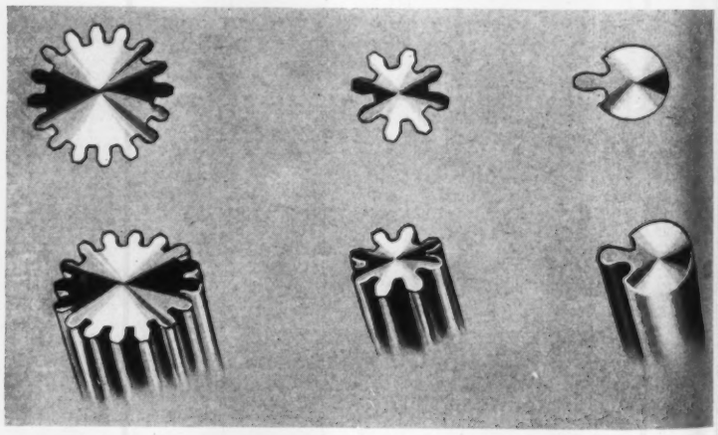


Fig. 2—Pinion rods may be accurately drawn as which is particularly valuable because of

By cold drawing bars into special shapes a tremendous amount of machining expense is obviated and labor cost reduced. Waste metal due to machining operations is eliminated. The savings in material frequently reaches 50 per cent.

and Extruded Sections in Designing

Editorial Representative, Machine Design

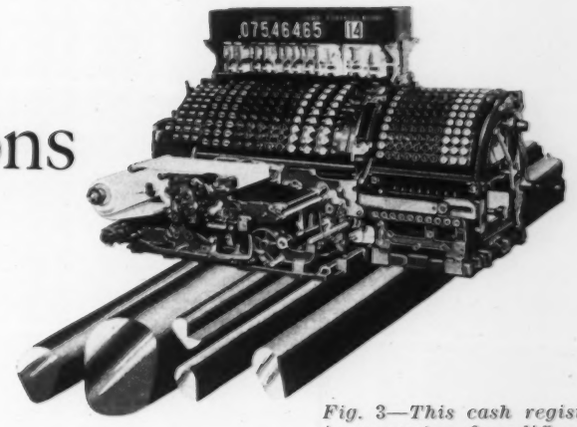
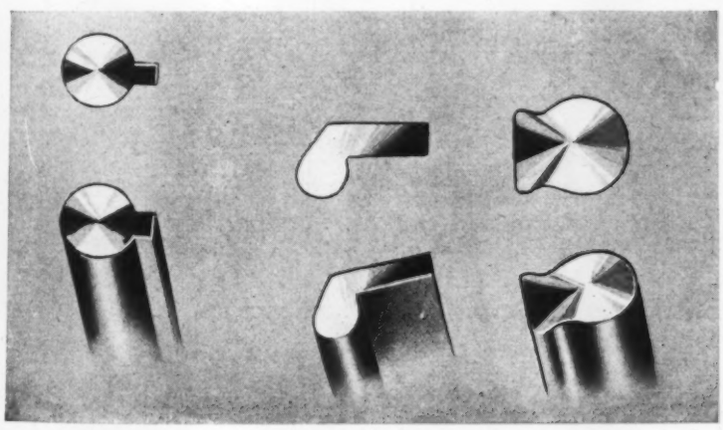


Fig. 3—This cash register incorporates five different special shapes

Referring again to Fig. 5, the upper sketch shows a lawn mover pawl in which the reduction in metal used amounts to 40 per cent. The scale pivot (lower sketch) produced by cold drawing also is representative of economy. In both sketches the area between the dotted and solid lines is wasted material when these parts are machined from bar stock.

The accuracy with which shapes are produced is an element of importance and one of the deciding factors for the advisability of their use. Tolerances usually specified are in accordance with the size of shape; under many conditions where the distribution of metal permits, these shapes are accurate within plus or minus 0.001-inch.

From the standpoint of economy no more interesting example could be shown for the use of cold drawn special shapes than that of the small blades for a turbine wheel as shown in Fig. 1. This unit of the turbine contains many of these small duplicated parts which must be formed accurately. To produce the finished part after the shape has been drawn it is only necessary for the manufacturer to cut the bars to proper length. This part is typical of many instances where common shapes such as flats, rounds, squares, etc., are machined at a large expense to produce the part which easily might be made by the cold drawing process.



special shapes with a refined structural surface friction between the teeth in operation

Cold drawn shapes are not recommended on the basis of economy alone. Cold finished steel is strong and is characterized by durability and high wear resisting qualities. Hardness increases with cold working, the latter often producing a gain of 15 to 20 per cent. Moreover, this method provides a smooth bright finish free from scale.

The drawing process by compressing and consolidating the texture of the metal gives a refined structural surface which is valuable; particularly so in pinion rods where there is constant friction between the teeth in operation. Fig. 2 illustrates an example of the type of pinion drawn from bar stock.

It is noteworthy that even when machining is required on cold drawn shapes the finished part retains a hard surface, which with other methods of production may have to be cut away entirely because of the milling or grinding necessary to obtain the desired contour.

Principle in Applications Is Similar

Examples of the use of special shapes could be extended to apply to design of machines used in practically all industries, but in each case the principle is similar. Their production is not affected by the analysis of the metal any more than in the manufacture of standard shapes. In the case of steel shapes they can be made in bessemer screw stock, open-hearth screw stock or in any of the numerous alloy steels. Nonferrous metals and alloys also can be cold drawn.

Among the more commonly known machines

in which cold drawn special shapes have been incorporated in their design is the typewriter. Fig. 7 shows the shape of the carriage rail as produced by cold drawing. The cash register in Fig. 3 utilizes five different shapes. Another instance is the feed dog of the sewing machine illustrated in Fig. 6. This important part is manufactured from a steel bar which is drawn to the proper shape, simultaneously assuming a bright finish while being drawn through the die. The oddly formed bar is cut to required lengths and machined quickly to finished dimensions.

Extrusion, the process of forcing preheated metal through dies under hydraulic pressure, lends itself advantageously to the economical shaping of copper, brass, bronze and aluminum and related alloys. As in the case of cold drawn shapes, extruded shapes have a high tensile strength, usually being much stronger than those made from cast metal. As the extruded metal is dense and thoroughly worked there is little liability of pin holes in the surface of the piece. Extruded metal is machined readily, and because of the smooth surfaces finishing costs are reduced to a minimum.

Like cold drawn shapes, extruded parts can be produced so close to specified design dimensions that machining is reduced greatly or eliminated entirely. As revealed in a Nielsen survey a prominent eastern electrical manufacturer has found the advantages of extruded shapes to include greater uniformity of finished pieces; higher electrical conductivity, decreased porosity and freedom from blowholes, avoidance of excessive scrap losses and reduction of time and cost for machine work in finishing.

Extruded Shapes Reduce Machining Costs

The use of extruded metal was begun by the company referred to in the survey several years ago in an effort to reduce machining and finishing costs on small parts going into the assembly of electrical instruments. The direct savings creditable to the introduction of extruded metal for a particular part totaled $0.3622 per piece, a cost reduction of 60.5 per cent. Furthermore, the pieces now produced are better suited for their function than those formerly made from castings and the total machining time has been reduced from 0.2725-hour to 0.0312-hour per piece. Production has thus been increased from 3.67 to 32.1 pieces per hour, a gain of about 775 per cent.

Electrical Units Embody Extruded Sections

Extruded metal now is being used in the manufacture of numerous other parts for electrical units with advantages similar to and cost reductions comparable with those described in the foregoing paragraph.

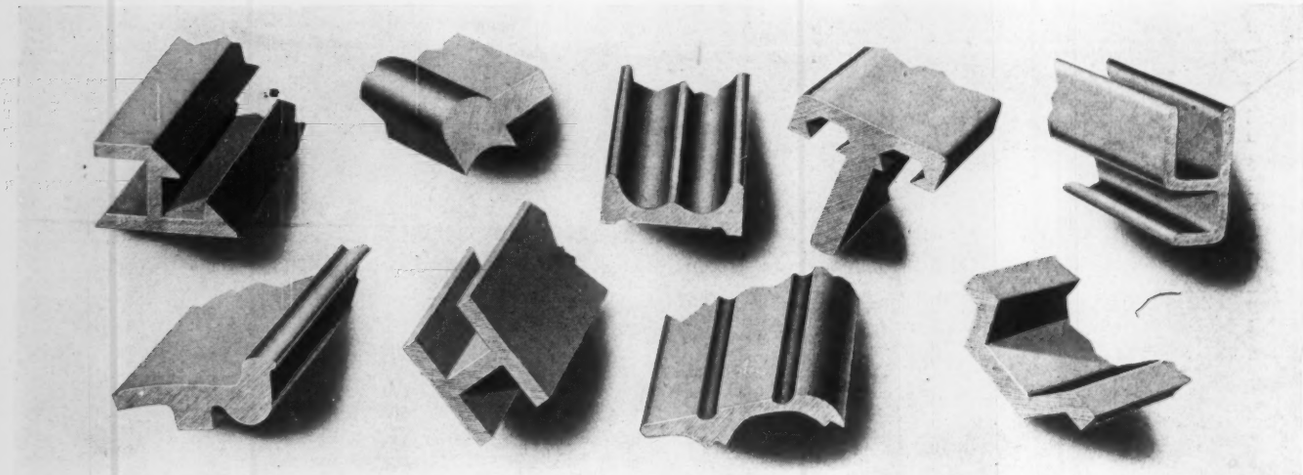


Fig. 4—Parts requiring intricate contours may be produced economically by the extruded process. A group of extruded sections are shown

The exact uniformity of extruded sections permits parts to be handled quickly and accurately in jigs and fixtures. With a special holder or chuck an extruded shape may be fed into a turret lathe or screw machine in long lengths, where it may be turned as readily as a concentric rod; or it may be sawed into short lengths and hot or cold forged with great economy in press operations and with a material saving in the amount of "flash" or waste.

Referring to Fig. 4 in which is shown a number of different extruded shapes, it readily can be seen how parts requiring intricate contours may be obtained from this process. The shape shown in the lower left hand corner of the illustration, after being extruded, is sawed into sections about 5/32-inch thick and cold forged to form the finished part. The shape in the upper left hand corner is extruded with a groove to hold rubber or felt strips.

Aluminum is one of those versatile materials which either can be drawn or extruded as point-

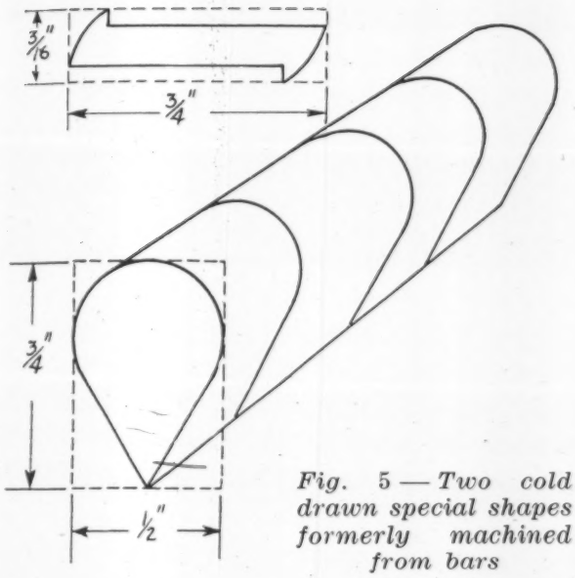


Fig. 5 — Two cold drawn special shapes formerly machined from bars

ed out in the article, "Applying Aluminum in Wrought Condition," by F. V. Hartman, which appeared in the June, 1930, issue of MACHINE DESIGN. Special shaped aluminum seamless tubing is among the more common products of the drawing process and, other than round, it is made into square, rectangular, elliptical and streamline shapes. Another application of aluminum shapes in the design of machinery is found in reciprocating, intermittently moving and rotating parts.

It is obvious that the reason for selecting aluminum is to reduce weight. In the case of regulating devices such as governors, the use of aluminum to accomplish this purpose also results in a more sensitive control. Tubing and structural aluminum shapes are used generally for long connecting rods and for frames or arms that reciprocate. Structural aluminum members are employed advantageously for built-up rotating parts where stresses are induced primarily by centrifugal force set up by weight of revolving members.

To lay down a hard and fast rule governing the use of the cold drawn or extruded special shapes would be difficult. There is one fact, however, that is worthy of careful consideration and that is the frequency with which it is found that exact duplicates of the same part are required in the manufacture of mechanical products. In such cases it would be difficult, if the nature of the part permits, to find a better process of producing it than by the cold drawn or extruding methods.

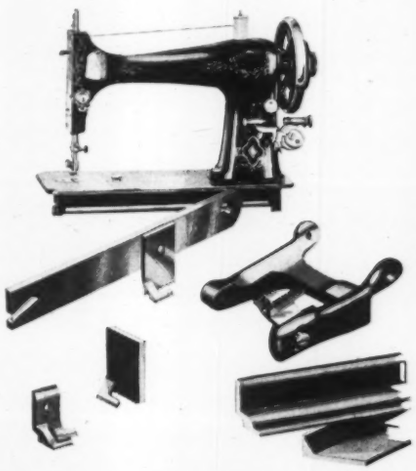


Fig. 6—Sewing machine feed dog is another part that is drawn cold

For co-operation in supplementing the material used as the basis for the foregoing, and for the loan of illustrations, MACHINE DESIGN wishes to acknowledge its indebtedness to the following companies: Columbia Steel & Shafting Co., Pittsburgh; Keystone Drawn Steel Co., Spring City, Pa.; A. B. & J. Rathbone, Palmer, Mass.; Union Drawn Steel Co., Beaver Falls, Pa.;

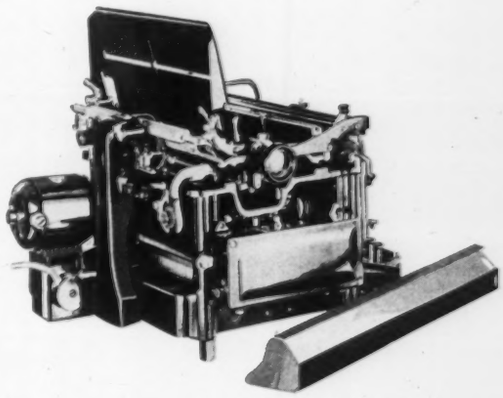


Fig. 7—Design of this typewriter embodies a cold drawn shape as the carriage rail

Aluminum Co. of America, Pittsburgh, Pa.; American Brass Co., Waterbury, Conn.; Revere Copper & Brass Inc., New York.

Processing Lowers Magnesium Cost

IMPROVED production methods and ample available deposits have reduced the price of magnesium metal 94 per cent in the last 16 years. The new prices are 30 cents per pound in carload lots and 32 cents per pound in less than carload lots. The average price for magnesium metal for 1915 as reported by the bureau of mines was $5 per pound. During these 16 years, according to Dow Chemical Co., Midland, Mich., production costs have been reduced consistently by means of process refinements brought about by extensive research. The newly announced price represents a remarkable production record that should instill confidence in those considering the use of or now employing magnesium alloys. Contrary to the opinion of many, magnesium is one of the most plentiful metals in the earth's crust.

Editorial

Is There an Untapped Market in Your Industry?

FROM time to time MACHINE DESIGN has emphasized the importance to builders of machinery of keeping a close check on conditions in the plants of customers and prospective customers. A letter received recently by the New England Council not only confirms what we have advocated but also shows that tangible benefits can be derived from systematic research of potential markets. The letter, written by the president of a company building shoemaking machinery, is as follows:

"A year ago we began a careful study among shoe manufacturers as to their requirements and asked them to advise in what way they believed we could assist them in improving the present models of the machines they were using. After gathering all these data by personal visits among the plants, we developed a new machine, and the first week in January of this year we commenced to put it on the market.

"Since that time our plant has been running on full time. We have made no reduction in wages and are in hopes not to have to."

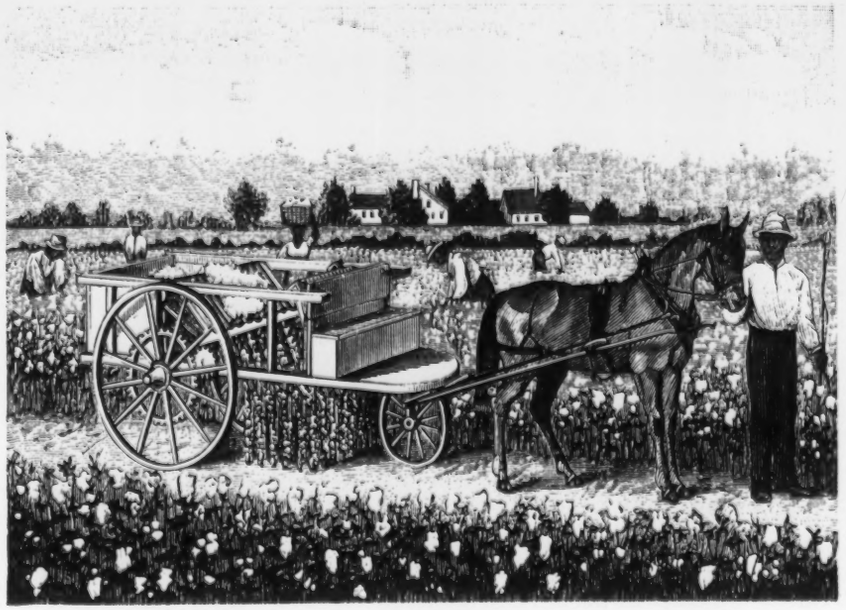
Opportunities similar to that described in the foregoing exist in almost every field where machines are used, and can be capitalized if the proper methods are employed. It is a job wherein initiative in engineering combined with co-operation from the sales and production departments—all functioning smoothly in accordance with an enterprising policy of company administration—can be utilized effectively in preserving an institution against the threat of depression.

The Need for Engines

THERE'S food for thought in the fact that the engines, discussed elsewhere in this issue, installed in the new Naval air cruiser, U. S. S. AKRON, are not of American manufacture. It has been said authoritatively that there is not available a domestic engine capable of meeting the requirements of this type of service.

Due credit must be given our builders of certain types of aircraft engines, particularly the radial, for outstanding performance. In the water-cooled class, however, especially in the higher powered units, engines built by foreign manufacturers appear to hold the advantage. As examples might be cited the engine used in the winning plane in the Schneider cup races, those installed in the racing car "Bluebird" and those in the power boat MISS ENGLAND II.

Is it too much to hope that domestic manufacturers soon will succeed in remedying this condition?



Reproduced from Oct. 1, 1881, issue, Scientific American

Early Machines—Developing the Cotton Picker

FIFTY years ago serious attempts were made to solve the problem of mechanical harvesting of cotton. Today, as related on pages 45-47, the difficulties encountered still have not been overcome successfully. Above are depicted various principles tried out in early machines, vibrating arm, revolving brush, reciprocating tongue and vacuum cup.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments from Our Readers. Machine Design Will Pay for Letters Suitable for Publication

Design Initiative—Effect on Depression

To the Editor:

THE biggest argument ever put forth in favor of the premise, advanced by C. G. Williams in the August MACHINE DESIGN, that hardly anyone can be found that is willing to spend money on experimentation or development is the statement published recently by noted patent attorney who says, "Nine out of ten companies of today are perfectly willing to buy an assured article or plan, but will not expend one copper penny in the interests of experimenting on that same article."

This is largely responsible for the slowness with which business is improving. I personally have heard more than one manufacturer complain that he had so much waste space he wished he could find something new to manufacture in it, yet when he was shown something which looked good he invariably answered, get it going and then we can do business.

Men and companies such as these discourage inventors and in turn retard the return to normal. Let us get back to the old plan of digging in and experimenting, investing money in experiments which generally yield a high return, and old man depression will receive a body blow that will be an enormous help in defeating him.

—CHARLES R. WHITEHOUSE,
Boston

Management's Responsibility in Design

To the Editor:

I WISH to congratulate you upon the editorial in the August issue of MACHINE DESIGN wherein the services that engineering departments might contribute toward the shortening of the depression are evaluated properly. Practically every engineering department has new designs under contemplation, either for improvements to present products or for new equipment.

The careful working out of such designs is important. However, in many cases designers are rushed to such a degree that features which would contribute to the efficiency of the mechanisms are overlooked. In other cases the method of manufacturing required due to the engineer's lack of time to consider better schemes makes the cost of producing such articles greater than necessary, thereby reducing the possible margin of profit or seriously affecting sales by not providing a competitive product.

Some companies even go so far as to advertise a new line of products for which the designs are incomplete. The sales department gets an order upon the basis of prompt delivery and then the engineering department has to sweat blood attempting to meet such promises. This is an ideal way to exert pressure upon the engineering department, but it does so at the expense of the manufacturing department.

With designs carefully thought out, and with drawings available for the manufacture of a product, a company is in a much better position to go after available business aggressively and meet delivery dates.

—CARL E. SCHIRMER,
Springfield, O.

Urges Competitive Specifications

To the Editor:

REGARDLESS of the merits of specification purchasing per se, there is often an indirect value of the specification system which seldom is realized and never emphasized. This lies in the intimate technical study of materials necessary in order to establish a competitive procurement specification. Without the specification system, designers in detailing an experimental or even a production model, will as a matter of course specify materials by a class or trade name, such as aluminum alloy, stainless steel, Bakelite, etc., entirely oblivious of the fact that there are many compositions, grades and types available under the general name.

The preparation of a proper competitive pro-

curement specification brings to light and obviates these difficulties. Furthermore, it leads to a proper engineering determination of the type or grade best suited to the particular class of work involved, and also leads to calling for the grade or type most economically suitable. In a highly competitive market for the finished product, the absence of proper specification analysis often may lead to calling for the best and most expensive grade of a given material, when the very properties which make it cost highest are entirely foreign to its particular utilization and add nothing to the value, functioning or life of the finished product.

The significant point is that the specification system provides a one-time thorough study of the situation at the most significant time, which is the inception of the use of the material, rather than a haphazard shot here and there with its attendant grief if the material is called for freely by a general or trade name. That it at times slows up procurement in its initial stages is granted, but it is a reasonable assurance that the material when delivered is proper and usable.

—JOHN F. HARDECKER,
Philadelphia.

Allocating Engineering Costs

To the Editor:

COSTS of manufacturing are based on the time it takes to make something from nothing. The costs of engineering are the paper record of what has been paid for ideas that were translated to paper. Ideal cost relations are attainable only when manufacturers can complete the product without loss through spoilage and delays through the interpretation of drawings.

However, the true cost of an engineering staff never can be timed by a clock. No one can estimate how many of the mechanisms of modern industry have been created in some engineer's mind when he was far away from office routine and systems. But some paper cost allocation is necessary, and a modicum of accuracy for the time spent in the office can be attained if the functions are split up.

During the time when the idea is in the process of being shaped into understandable form, either by sketches or rough layouts, a number should be assigned and all the time taken in the engineering office charged to this number. After approval, another number, known as the design or layout number can be assigned and all time charged to it. On completion of the design or layouts, the manufacturing drawings and assemblies are charged to another number representing the working drawings in a group. Miscellaneous charges such as checking and changes are assigned time numbers also. It is best to prorate supervision time proportionately over the work. Total time is then ascertained and total cost of engineering prorated to the total cost of product.

—H. L. LACKMAN,
Philadelphia.

Will Needle Bearings Gain Headway?

To the Editor:

NEEDLE bearings are again gaining prominence in discussions pro and con as evidenced in the June and August issues of MACHINE DESIGN. I believe the first bearings of the type we now designate needle bearings was used in 1903 in the Pratt and Whitney factory, but here all of the rollers were at least 3/16-inch diameter and not over 2 inches in length.

While we in the United States have been going to larger balls and rollers in our bearings, certain experimenters in France, and at least one in America, have been going in the opposite direction and using smaller rollers.

It is believed that not ten out of a hundred designers and engineers in this country know what a needle bearing is—can say offhand what constitutes the needle bearing. A true needle bearing is one having a close fitting cage or housing of hardened steel enclosing between it and the hardened steel shaft, rollers of a size that may be designated as needles, from 0.025-inch diameter in the smaller sizes, up to not over 0.125-inch diameter in a bearing for a shaft 6 inches diameter and over. Perhaps in a bearing for a shaft 3 inches diameter we could better designate it as "grandma's knitting needle" roller bearings, the rollers being about 0.078-inch diameter.

In an experimental model of a machine made here some years ago, there was not enough room to install a conventional roller or ball bearing, so a true needle bearing was tried. It was to run at 1750 revolutions per minute. There was room only for a 3/16-inch bushing and a set of needles about 1⅞-inch long, so they were put in. Because of peculiar conditions, no bronze bushing would last over three months. This new needle bearing on a 1-inch shaft gave fine results.

The true needle bearing has not been used in America even in experimental shops, for the true type on a 2-inch shaft would not be over 1½ inch long and the rollers should not be over 0.032-inch diameter. The true "knitting needle" having a diameter of 0.078-inch is too large for this shaft and will not give the best results.

Personally, I am convinced that the real needle bearing will find a place in our industry. It will never "come back" for it has never been here to come back.

—C. G. WILLIAMS,
Green Bay, Wis.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

CHIEF draftsman at the age of 17, works manager at 19 and director at the age of 20—such is the early record of Charles G. Garrard, who recently was awarded the Edward Longstreth medal by the Franklin Institute. The token is presented for inventions of high order and for particularly meritorious improvements and developments in machines and mechanical processes. It went to Mr. Garrard for his remarkable invention, the adhesion type speed changer which the Crocker-Wheeler Electric Mfg. Co., Ampere, N. J., has secured license to manufacture in the United States and Canada.

Born in 1881, Mr. Garrard left elementary school in 1894 at the age of 13 to work in France. Already in 1900 he had to his credit the design of automatic and other types of machinery. During his employ with an internal combustion engine firm he designed what proved to be one of the most popular of two-cycle engines. After the World war he acted as consulting engineer and machine tool specialist, and later formed Garrard Gears Ltd., Dunstable, Bedfordshire, England. Mr. Garrard's skill amounts to positive genius and has been directed to solve a great variety of mechanical problems, more particularly those pertaining to automatic, quantity production machine tools.

RAISING a college of engineering to a place in the front rank is a most notable achievement and one of which Dean Herbert S. Evans, Colorado university, is justly proud. Now his service to engineering is enhanced further by his becoming president of the Society for the Promotion of Engineering Education. His election took place at the recent thirty-ninth annual meeting of the organization at Purdue university.

Dean Evans came to Boulder, Colorado, in the fall of 1905 to take the professorship of electrical engineering at the university. In 1918 he was made acting dean of the college of engineering and in 1919 became head of the department. In preparing for his work he studied at the University of Nebraska, obtaining his bachelor of science degree in electrical engineering in 1898. Subsequently he was associate professor there for several years, and three years ago the honorary degree of doctor of engineering was conferred upon him by that institution.

Aside from his duties at the university he has been retained by General Electric Co., Schenectady, N. Y., and has done consulting engineering work. He is a member of several honorary engineering fraternities including Sigma Tau, Sigma Xi, Tau Beta Pi and takes an active part in the American Institute of Electrical Engineers. He also is a member of the National Electric Light association.

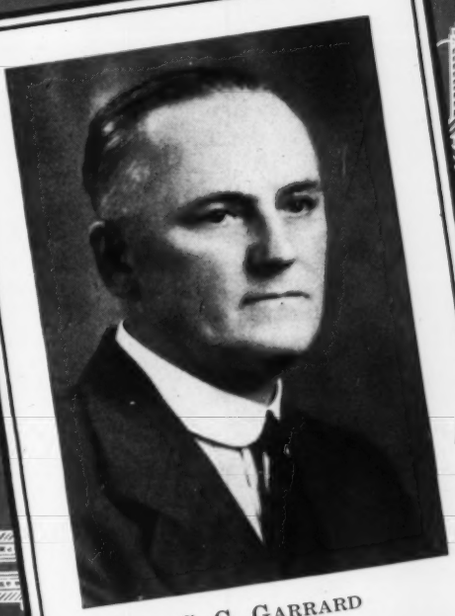
TECHNICALLY trained and thoroughly experienced in automotive engineering, H. C. Snow holds a high place in the profession as vice president in charge of engineering of the Auburn Automobile Co., Auburn, Ind. Prior to his comparatively recent appointment, he had been chief engineer of the organization since July, 1927.

Mr. Snow received his technical education at Case School of Applied Science, Cleveland. He started in 1904 as draftsman with the American Ball Bearing Co., Cleveland, which was one of the first specialists in the manufacture of automobile axles. The following year he worked as a detailer and designer with the Garford Mfg. Co., Elyria, O. Leaving there in 1906, he joined the engineering department of Peerless Motor Car Co. and for the next six years was successively, designer and chief draftsman.

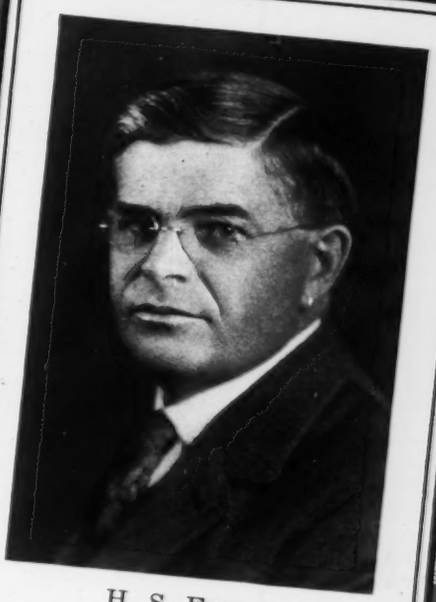
In 1912 and 1913 he was assistant chief engineer of Willys-Overland Co., Toledo, O., returning again to Cleveland in 1914 to become designer and experimental engineer for the Winton Co. After remaining with this company seven years, during which time he rose to the position of chief engineer, he took up consulting engineering work for the next three years. Subsequently he was chief engineer of the Velie Motor Car Co., Moline, Ill., and then joined his present company.

BETTER known for his work in connection with the design of trimotored Ford transport airplanes and also as "the man who sold aviation to Henry Ford," William B. Stout holds an imposing engineering record. This makes his recent nomination as a vice president of the So-

Leaders in Design, Engineering and Research

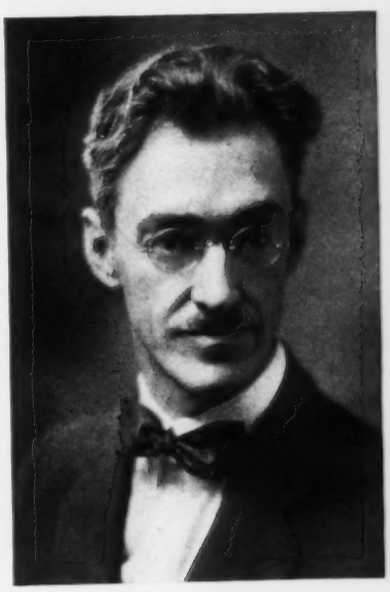


C. G. GARRARD



H. S. EVANS

H. C. SNOW



W. B. STOUT

ciety of Automotive Engineers doubly impressive. Obtaining his mechanical engineering training at the University of Minnesota with the class of '04, Mr. Stout since has been associated with the automotive and airplane industries in various capacities.

He was on the editorial staff of *Motor Age* and *Automobile* in 1912, later moving to Detroit as chief engineer of Scripps-Booth Motor Co. Subsequently he was retained by Packard Motor Co. as chief engineer of its airplane division. During the World war he was technical advisor of the aircraft board in Washington. Mr. Stout developed the first army cantilever, veneer wing plane built and the first cantilever wing monoplane flown in this country.

About 1923 he organized the Stout Metal Airplane Co. to build commercial metal planes. His work attracted the attention of Henry Ford who purchased the entire corporation and placed him in charge. During this time the tri-motored Ford transport was developed. In the past two years Mr. Stout has been engaged in his own engineering laboratory in Dearborn in the development of a plane called the "Sky Car." His laboratories also are concerned with the development of light weight duraluminum structures for other industries.

* * *

George H. Kublin has been appointed chief engineer of the Auburn Automobile Co., Auburn, Ind. He has been associated with the company for three years, having held the position of assistant chief engineer. His wide experience in the automotive industry covers a period of 17 years.

* * *

Roy J. Wensley, creator of the televox, first of the popular mechanical robots, has been transferred from the East Pittsburgh engineering department of the Westinghouse Electric & Mfg. Co. to the meter department of the Newark works of the company, according to the announcement of R. S. Feicht, director of engineering.

* * *

A committee on machine design has been appointed by F. C. Spencer, chairman of the machine shop practice division, American Society of Mechanical Engineers. This committee will arrange for papers on machine design to be presented at meetings of the society and will, in general, co-ordinate the activities of members interested in this phase of engineering and manufacturing. Those appointed are: Frank L. Eidman, chairman, professor of mechanical engineering, Columbia university; Joseph B. Armitage, chief engineer, Kearney & Trecker Corp., Milwaukee; G. H. Ashman, engineer, General Electric Co., Schenectady, N. Y.; George F. Cosgrove, president, Cosgrove Technical Service; George F. Nordenholt, associate editor, *Product Engineering;* Frederick Franz, consulting engineer; Albert Palmer, assistant to general manager, Crompton & Knowles Loom Works.

* * *

F. Hugh Morehead, chief engineer, Walworth Mfg. Co., Boston, recently was elected vice president in charge of engineering at a meeting of the board of directors.

* * *

Arthur Schroder has severed his connection with the Fisher Scientific Co. and now is affiliated with the Aluminum Research Laboratories at New Kensington, Pa., as chief engineer.

* * *

K. F. Hetherington, formerly consulting engineer, Mishawaka, Ind., recently was appointed assistant engineer with the Upper Mississippi valley division, U. S. Engineer Service, St. Louis.

* * *

F. M. Farmer, representing the American Institute of Electrical Engineers and American Welding society, has been appointed chairman of the American Standards association's sectional committee on electric welding apparatus.

* * *

Leo G. Hall has been appointed to the staff of the Ryerson physical laboratory at the University of Chicago, in connection with experimental research in metals and alloys. Mr. Hall will continue his private consulting practice on problems and designs connected with high temperature, high pressure, and suitable electrochemical technique and apparatus.

* * *

Anthony H. G. Fokker has resigned as consulting engineer of Fokker Aircraft Corp., a subsidiary of General Aviation Corp., in order to develop plans which he has had under consideration for some time. Mr. Fokker, however, remains a large stockholder and a director of General Aviation Corp. which is controlled largely by General Motors Corp.

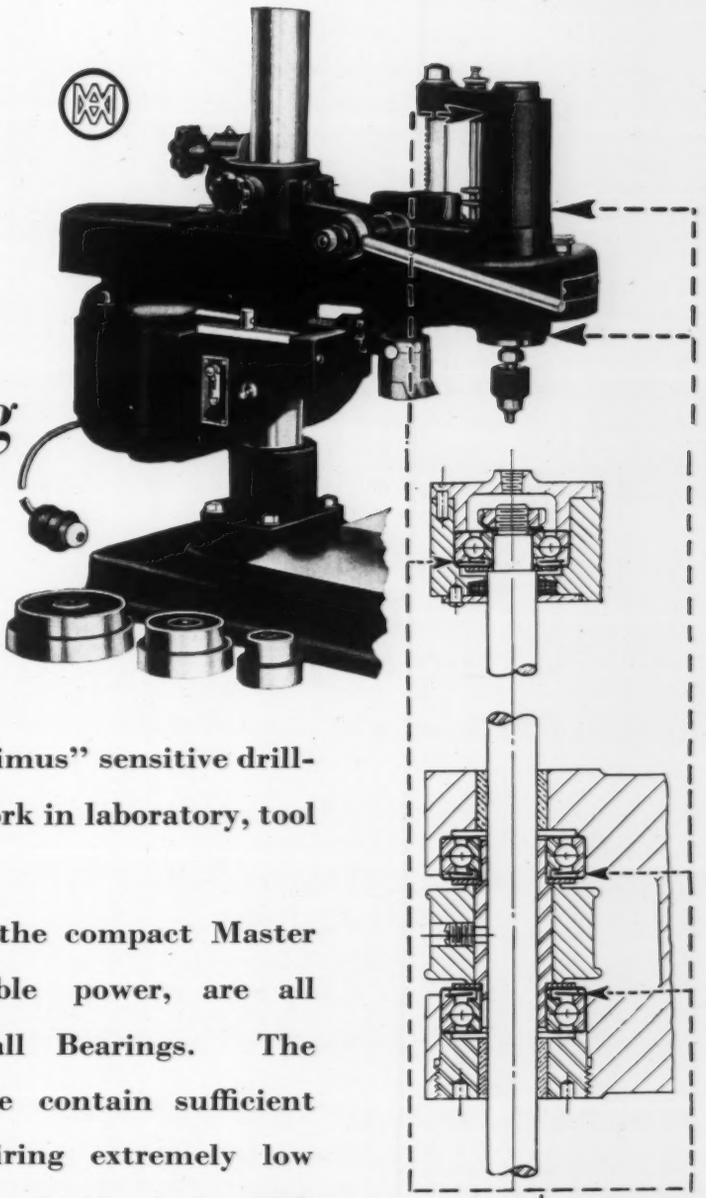
* * *

G. B. Haven, professor of machine design, Massachusetts Institute of Technology, has been appointed to represent the American Society for Testing Materials on the sectional committee on specifications for leather belting, which is functioning under the procedure of the American Standards association with the American Society of Mechanical Engineers as sponsor.

SRB *Lubri-Seal* BALL BEARINGS

MAINTAIN EXTREME SENSITIVITY FOR

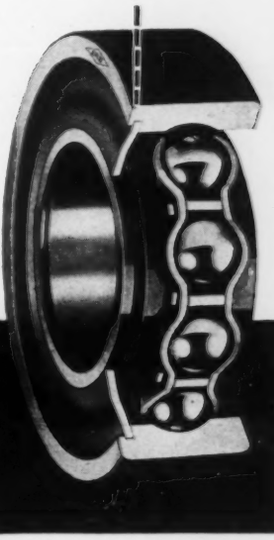
"Maximus" Drilling Machines



THE quality and capacity of the "Maximus" sensitive drilling machine fit it for a wide range of work in laboratory, tool room and production department.

• The drill spindle, drive pulley and the compact Master Electric Motor that furnishes reliable power, are all equipped with SRB Lubri-Seal Ball Bearings. The shielded bearings on the drill spindle contain sufficient grease to last a year . . . requiring extremely low maintenance attention. The built-in shield of the SRB Lubri-Seal also protects against dirt and grit. Thus the original sensitivity of the "Maximus" Drill is lastingly maintained through the protection of SRB Lubri-Seal Ball Bearings.

STANDARD STEEL AND BEARINGS INCORPORATED
DIVISION OF MARLIN-ROCKWELL CORPORATION
Plainville *Connecticut*



Ball SRB Bearings

Assets to a Bookcase

Review of Books Pertaining to Design

Design Calculations

Elastic Energy Theory, by J. A. Van Den Broek, cloth, 260 pages; 6 x 9 inches; published by John Wiley & Sons Inc., New York, and supplied by Machine Design for $4.50, plus 15 cents postage.

It is Prof. Van Den Broek's contention that the theory of elastic energy within the assumption of elastic behavior of material and the principle of superposition, will accomplish all that any other theory or method will do. Furthermore, he believes that it is not only the most general theory available, but it also is the simplest and easiest to grasp.

Chapters cover such subjects as analysis of frames, combined bending and direct stress, elastic energy and deformations due to shear and resilience which takes in beams of constant strength, leaf, helical and spiral springs. Every effort has been made by the author to eliminate confusion. Because of its simplicity the graphic summation method is used.

□ □ □

Story of the Autogiro

Wings of Tomorrow, by Juan de la Cierva and Don Rose, cloth, 300 pages, 5½ x 8 inches, published by Brewer, Warren & Putnam Inc., New York, and supplied by Machine Design for $2.50, plus 15 cents postage.

Although written to appeal to an air-minded public, technical men will find the story of the autogiro as told by the inventor, intensely absorbing. Introducing this volume to the reader with a discussion on flying by machinery, the events leading up to the development of a new type of airship are interestingly reviewed by Don Rose.

It was by a return to first principles that the autogiro was discovered and developed, the reader is informed. Juan de la Cierva, an ambitious young engineer, well started on an aeronautical career and having in mind the perfection of the plane, conceived the idea of looking in the other direction to the beginning of the science of flight. This was the real genesis of the autogiro.

Discussing what might be called revolutionary types of airplanes, Senor Cierva dwells to some extent on the heliocopter. The apparent similarity between the practical autogiro and the experimental heliocopter, he says, has misled many casual observers to mistake the new craft for "another heliocopter," which it is not. The book no doubt will attract a great deal of interest in view of the enthusiasm in the autogiro.

An article on the autogiro appeared in the May, 1931, issue of Machine Design. In the March, 1930, issue a picture and biographical sketch of Senor Cierva also were presented.

□ □ □

A Study in Economics

Economics for Engineers, by Edison L. Bowers and R. Henry Rowntree; cloth, 489 pages, 6 x 9 inches; published by McGraw-Hill Book Co. Inc., New York, and supplied by Machine Design for $4, plus 15 cents postage.

With increased attention being reflected on the study of economics to assist business out of its depressed state, this book, written specifically for engineers, is particularly noteworthy. Moreover, the volume differs from the usual discussion of economics inasmuch as it is directed to technically trained minds. Because of the demands on the time of engineers the authors have not made a lengthy presentation of subject matter.

The relationship between economics and engineering is outlined clearly. Practical achievements of engineering depend on the economic system, upon which these in turn exercise a profound influence.

Constituting a text book on economics chapters in this new volume cover such subjects as consumption, the evolution of modern industry, business units, financial structure, domestic marketing, international marketing and finance, competitive, controlled and fixed prices, wages and salaries, and other topics of interest to the executive engineer.

□ □ □

Design Materials

Metals and Alloys, cloth, 136 pages, published by Louis Cassier Co. Ltd., London, England, and supplied by Machine Design for $2.65 plus 15 cents postage.

Percentage compositions of some 3500 alloys are listed in this volume which is indicative of the progress made in the science and practice of metallurgy during the past ten years. The listing is alphabetical, beginning with accumulator metal and ending with ziskon, a metal containing 40 per cent zinc and 60 per cent aluminum. In many instances the alloys are listed under a collective head and under trade names.

A large Valve Company

cut machining costs 40% with

Revere Brass Forgings

For years, a well-known manufacturer of valves used nothing but red brass castings in the manufacture of valve bonnets. Recently, that company decided to try Revere Brass Forgings instead.

So, forgings were ordered for one of the smaller size valves. The results of this trial proved so satisfactory that Revere Brass Forgings are now being used for bonnets in the entire line.

The change-over from castings to forgings has brought many worthwhile advantages. Machining time is reduced, machining costs are lower by 40%, rejects are eliminated. Cost records show that, even though the cost of a forging is more than that of a casting, the final cost of finished forgings is appreciably less than that of a finished casting.

More important still, it has been found that bonnets made from Revere forgings are lighter, stronger and better looking than the old bonnets ever were. Added to this is the absolutely uniform quality, due to the fact that the composition of Revere Brass Forgings, once determined for a particular use, is constantly maintained by close technical control.

Valve bonnets, made from Revere Brass Forgings. Notice how clean-cut they are before machining. Cost of machining is reduced 40%... rejects are eliminated. A stronger, better, neater-appearing bonnet results.

In your own plant there may be production difficulties which can be overcome by forgings. Revere offers you the services of its research and technical staff. Revere Brass Forgings developed to meet your particular needs can duplicate the savings and satisfactory results obtained by this progressive manufacturer.

For further information, address Revere Copper and Brass Incorporated, 230 Park Avenue, New York City.

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TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

SUPPLEMENTING the various items concerning the patent office which have appeared from time to time in these columns comes the news that improved facilities for the granting of patents will be available before the first of next year. This will be because the patent office moves into the entire north third floor of the new Commerce building at Washington. In the new quarters, inventors and research workers will be provided with a vast search room which will have a ceiling two stories high and a correspondingly large and well lighted scientific library.

Kept in stock for sale will be about 10,000,000 copies of patents already granted, to meet the sales of patent papers which reaches approximately 3,000,000 copies annually. Organized in 1790, the patent office granted the first patent to one Samuel Hopkins on July 31 of that year, and the second was taken out by Joseph Stacey Sampson on August 6 "for the manufacture of candles."

Before the Civil war commenced more than 30,000 patents had been granted and by 1870, inventive genius having been stimulated by the war, the number had risen to 40,000. Now the patent office issues more than 40,000 patents annually.

* * *

Discovers Things That Engineers Dislike

ENGINEERS dislike pet canaries, amusement parks, poetry, radical magazines and auctions more than other men according to tests conducted by Dr. Walter Van Dyke Bingham, director of the Personnel Research federation of New York, who recently talked before a group at Stevens Institute Engineering camp at Johnsonburg, N. J.

The doctor said further that engineers as a class dislike people who borrow things; they are indifferent to people who agree with them, and dislike raising money for charity. They frequently dislike men who are natural leaders and they prefer to pass nights at home rather than away, said he.

* * *

Formulate Plans to Fight Unemployment

MEASURES for carrying on a sound fight to provide and maintain employment comprise a program instituted by the American Engineering council and submitted to its member societies for mobilizing engineers throughout the country to take part in the issue. The opportunity for members of the profession to carry out the plans against unemployment is emphasized. Alternate plans are suggested for use of engineers working through local units. Headed by F. J. Chesterman, vice president, Pennsylvania Bell Telephone Co., the committee has had its report approved by the council's executive committee and the contents will be made public in the near future.

* * *

Use of Domestic Oil Burners Increases

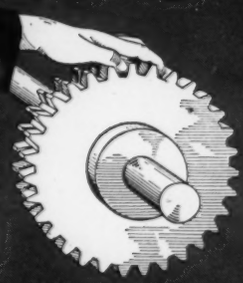
DOMESTIC oil burners in use in this country have increased from 12,500 in 1921 to more than 750,000 and it is estimated that by the end of the current year the total will have grown to 774,500, according to a survey recently completed by the American Oil Burner association. Figures covering commercial oil heating installations show that the number has increased from 24,000 in 1925 to 42,400 in 1931.

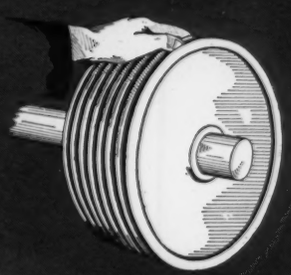
The percentage of increase in the oil burner industry, it is suggested, is somewhat greater due to the fact that exports, which have shown a decided increase in recent years, and industrial installations which also have increased, are not included in the analysis. Also the figures include only the number of burners in operation at the present time and are not based on the total sales of domestic burners over the past ten years which are estimated at 865,100 as against 774,500 in operation at the end of the current year.

* * *

Farm Machinery Effects Cost Reduction

SIGNIFICANT of the role of improved machinery in this day of reduced prices for farm produce are the findings of F. M. Sacay of the New York College of Agriculture who states that new combined harvesters and threshers have more than cut in two the costs of harvesting grain in New York state. Records of 31 machines which harvested 5171 acres, or a total of 154,698 bushels, show they did the trick for a cost of $3.10 an acre against a cost of $7.88 for the grain cut with a binder and then threshed. On the average 1.53 acres were cut

IT'S EASIER TO turn THIS wheel than this  or this..



Remember this when you compare Chain Drives with Belts

MORSE Chains cannot slip—they are flexible and do not have to run tight in order to do their work. The illustrations above explain why.

Morse Chains grip the teeth in much the same manner as your fingers would if you were turning the wheel by hand.

Place your hand flat on a pulley and try to turn it. Your hand tends to slip no matter how much pressure you exert. You see how much greater pressure must be exerted on shaft and bearings.

Put grooves in the pulley and you gain more purchase, but still there is a tendency to slip.

Try this little experiment yourself. Then add flexibility, ease of installation, high efficiency, quiet operation, low maintenance cost and extremely long life, and you have the reasons why Morse Drives are the choice of so many leading industrial concerns.

Our engineering department will gladly work with you.

MORSE CHAIN COMPANY · ITHACA, N. Y.

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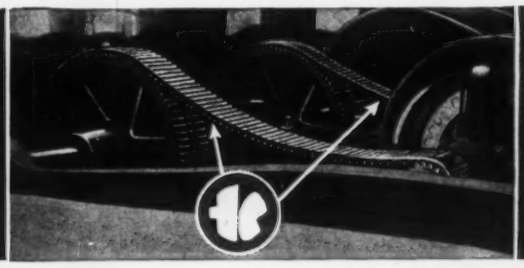
MORSE CHAIN DRIVES



QUIET · POSITIVE
SMOOTH
LONG LIFE
98.6% EFFICIENT

and threshed in an hour. Advantages in using the machines are: Saving in cost, in labor, in time, in grain, and in spreading the straw on the field. Disadvantages are: High investment, averaging $1394, and greater risk of grain heating in storage.

* * *

Engineering Schools Enrollment Gains

THE past five years shows a gain of 40 per cent in the enrollment in engineering schools throughout the country according to W. C. John, of the federal office of education. Total enrollment in 145 leading engineering colleges reached 78,685 for 1930-31, of whom 73,386 were undergraduate students and 2939 graduate students of engineering.

Now enters the problem of placing college graduates and F. L. Bishop, secretary of the Society for the Promotion of Engineering Education, says that only 38.2 per cent of the 1931 graduates of 88 institutions have been placed, or 2240 out of 5866.

* * *

Provide Fund for Cyrus H. McCormick Medal

A GIFT of $10,000 has been presented to the American Society of Agricultural Engineers by Cyrus H. McCormick, Mrs. Emmons Blaine and Harold F. McCormick, children of Cyrus Hall McCormick, the inventor of the reaper, to be used by the organization in recognizing outstanding work in agricultural engineering.

Part of the endowment will be spent on the design and die for a gold medal to be known as the "Cyrus Hall McCormick Medal." The income from the remainder will be used in conferring the medal, with a cash award, on agricultural engineers selected to be honored.

* * *

Says Scientific Management Is Necessary

THE application to entire industries the world over of the principles of scientific management which have played such an important part in the growth of American industries during the last half century was proposed as a way out of the present world dilemma by Dr. H. S. Person, managing director of the Taylor society, in an address before the World Social Economic congress which was held recently at Amsterdam on the call of the International Industrial Relations association.

Logic compels us to consider the necessity of ultimate stabilization of world industry by a world-scale application of the principles of scientific management, declared Dr. Person, speaking before an audience of economists, industrialists, governmental officials and labor leaders from the principal nations of the world. "All the forces of national habits, prejudices, chauvinism and entrenched self-interest are arrayed against such an ultimate application of these principles. Yet boldness in thinking and in conduct ever have been the basis of progress."

Predicting that America would probably be the last country "to give effective response to this concept of international stabilization" Dr. Person said, "let us not forget that the American is flexible and adjusts himself to new requirements more readily than most people. Until recently there has been no need for the American to be internationally minded. In recent months, however, there has been startling evidence that industrial leadership in the United States has begun to think internationally."

* * *

American Inventors' Day To Be Observed

BEGINNING September 14 Chicago's second international patent exposition opens in the Merchandise mart where 32,000 inventions will be placed on display for two weeks. Special program has been arranged for "American inventors' day" on September 26 when Henry Ford, Michael Pupin, Owen D. Young and other famous inventors and scientists will be invited to take part. One feature to which attention is called by Harry S. Green, exposition sponsor, is that none of the 32,000 inventions ever has been placed on the market.

* * *

Better Engine Balancing Is Needed

ONE form of refinement in automobile powerplant design which is not noticeable to the layman but which is very readily recognized by the technician, is that of proper balancing. So potent are unbalanced forces that their effect at certain speeds and under certain conditions becomes highly disastrous, the Society of Automotive Engineers' experts declare.

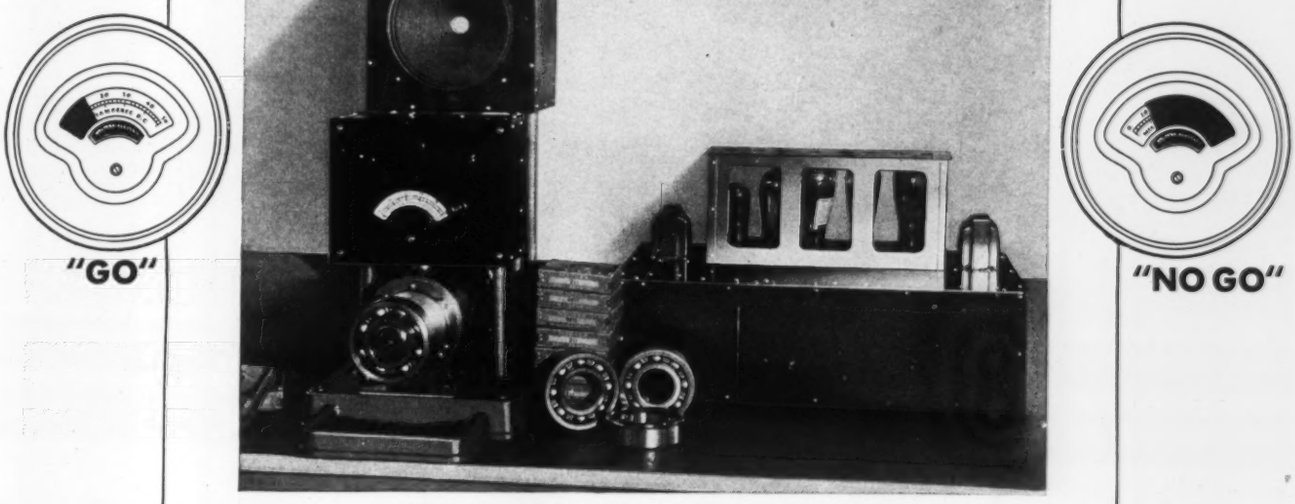
Smoothness of engine operation is thus just now receiving much consideration. Various forms of dampers, harmonic types of balancers, forms of centrifugal control are being introduced to eliminate these "troublesome tremors." The motor public will benefit by this work in better riding quality and economy of operation, especially of maintenance.

* * *

Celebration To Honor Michael Faraday

COMMEMORATING the one hundredth anniversary of the discovery of electromagnetic induction in 1831 by Michael Faraday, who blacksmith's son though he was, has come to be known as the "creator of the age of electrical power," the Royal Institution and the Institution of Electrical Engineers of London, in co-operation with other British scientific societies, are arranging a centenary celebration to be held September 21-23. Government and university bodies as well as other scientific interests also have joined hands in offering their co-operation and assistance to make the celebration worthy of the occasion.

AN EXCLUSIVE HOOVER DEVELOPMENT



$8500 worth of new scientific apparatus used to test the smoothness and quietness of Hoover Bearings

★ ★ ★

RADIO USED FOR noise TEST OF HOOVER BEARINGS

The smoothness and quietness of Hoover Bearings is not left to the judgment of the human ear with its attendant variations and inability to accurately detect and classify sound.

Over $8500 has been invested in electrical engineering to design and build for exclusive Hoover use, a scientific radio device (illustrated above) to test the quietness of Hoover Bearings with infallible accuracy. A whisper coming through the loud speaker is amplified into a thundering roar. The sound is not only amplified but is actually recorded upon a gauge in milliamperes.

A definite "go" and "no go" standard has been established. Every Hoover Bearing is sound tested and checked on this apparatus and approved or rejected according to the rigid standards set for smoothness and quietness that can now be maintained with accuracy. Guess-work has been entirely eliminated!

This is but one of many reasons why Hoover Bearings are now used as original equipment by more than 100 leading manufacturers in the Machine Tool, Automotive, Electrical and Industrial Fields.

HOOVER

Undisputed Excellence

BALLS — BALL BEARINGS — ROLLER BEARINGS

THE HOOVER STEEL BALL COMPANY, ANN ARBOR, MICHIGAN

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

WITH pneumatic gear shift mechanisms a timely automctive engineering topic, the invention of the control unit recently patented by Harry T. Goss, Rutherford, N. J., becomes particularly pertinent. The entire structure is mounted in a single casing, thus avoiding the danger of one element coming loose and preventing operation of the valve when needed.

As shown in Fig. 1, *A* is a side elevation partially in section, to illustrate the valve, its controlling mechanism and vacuum takeoff; *B* is a plan view of the quadrant. A portion of the casing is broken away in *C* to show the air conduits and valve rotor in horizontal position and *D* is the metallic diaphragm.

Six holes occupy section 16, namely 118, 120, 122, 124, 126 and 128, of which three 118, 120 and 122 register with grooves or ducts 112, 114 and 116, respectively. The other three holes 124, 126, 128 are connected by means of registering perforations in gasket 104 with grooves, 106, 108 and 110 respectively in the upper section 14. Five of the holes are provided with tubes, four of which 118, 124, 126 and 128 are connected at their other ends with cylinders of the gear shifting mechanism. Hole 122 is connected to the intake manifold of the motor and the sixth hole 120 opens directly to the atmosphere and serves to allow air to enter the gear shifting cylinders to restore the pistons to neutral position.

The vacuum line feeding into hole 122 through conduit 116 and port 90 into groove 88 can be applied by turning handle 54 tc any of the ports 92, 94, 96 or 98. Whichever port has been joined to the vacuum line, its corresponding gear shift cylinder then is evacuated through its connecting conduit, hole and pipe 134. All the other cylinders simultaneously are vented through hole 120, conduit 114 and groove 86 to receive the atmosphere and to neutralize the positions of the pistons.

Universal Gear Shift Corp., New York, is assignee of the patent which has been designated No. 1,817,365.

INTEREST in the comparatively recent invention of adhesion type speed changers brings attention to a patent issued for an idea which eliminates relative displacement of the satellite rollers of such units. Due to minute inaccuracies in parallelism of these members caused by failure to grind the surfaces truly cylindrical instead of slightly coned, or to identical diameters, it has been found that in change speed gearing with cylindrical surfaces in friction or adhesion engagement, there is a tendency of one or the other of the members to be displaced in the direction of its axis. Such displacement produces a disturbing effect on the operation of the mechanism.

Referring to Fig. 2, *A* and *B*, it can be seen that surrounding the satellite rollers 7, 7, is an outer race in two parts, one of which, 11, is in engagement with one of the beveled surfaces of each of the rollers and is restrained from rotating. The other half 12 is in engagement with the other beveled surface of each of the satel-

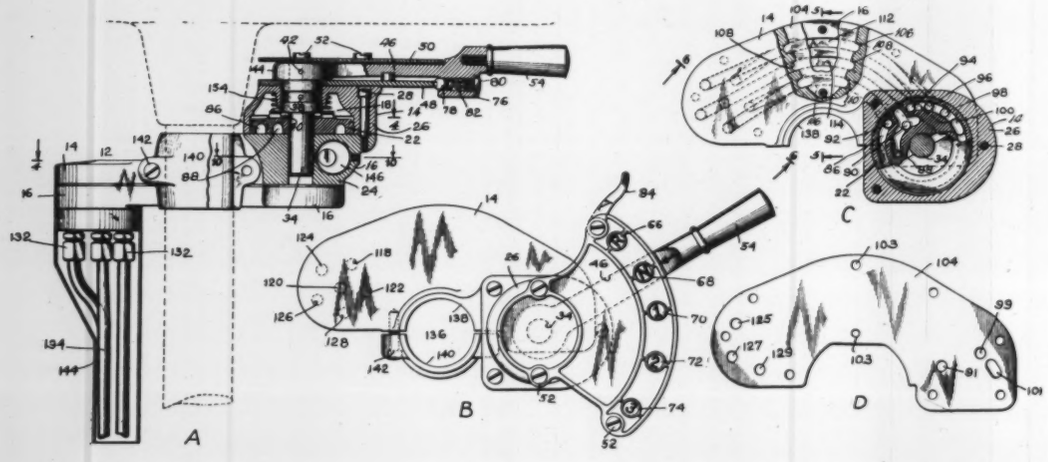


Fig. 1—A shows the valve control of a pneumatic gear shift mechanism; B is the quadrant; air conduits and valve rotor are shown at C, and D is the metallic diaphragm

Vitreous-enameled steel tub and galvanized-steel cylinder for an apartment-type washing machine turned out by G. P. & F. for a leading tool manufacturer. Both stamping and finishing were done by G. P. & F.

Isn't THIS the type of Service you are Looking For?

G. P. & F. has been furnishing stampings to a well-known machine tool company; so well has G. P. & F. done its job that when this tool company expanded into the washing-machine field it came to G. P. & F. for the sheet-metal parts, on the basis of service rendered.

This is not just a case of "Oh, well, they've been doing our stampings; let's give the new job to them." The reason any company comes to G. P. & F. and keeps coming back, is the fact that here is a company old in experience (more than 50 years of it), here is a company that honestly tries and better than that *knows how* to give its level best, a company that has brought its old-time standards and ideals of craftsmanship and sincere workmanship into mass production, a company that is relentlessly on the look-out for every means of bettering your product and saving money for you at the same time.

19-acre plant facilities assure you A-1 production and prompt delivery whether you want plain pressed metal parts or any of the modern lithographed, enameled or lacquered finishes.

You will find too that G. P. & F. estimates are right and — when everything has been counted up—usually lower than those of plants less fortunately equipped.

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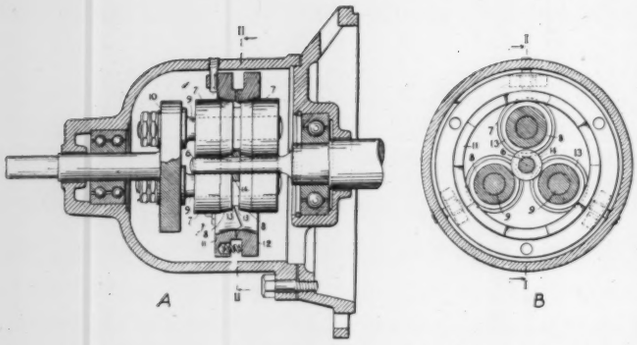


Fig. 2—Adhesion type speed changer in which displacement of rollers is obviated

lite rollers. Because of this race being in two sections, the parts have a tendency to depart a little from their concentric relation and therefore do not properly restrain the satellite rollers from axial displacement.

To prevent this condition the satellite rollers are provided with grooves turned in them, preferably between the opposed cone surfaces. These, thereby, provide the rollers with shoulders 13, 13. A ring 14 enters the grooves and by engagement with the shoulders of the satellite rollers restrains them from displacement.

Either the fast speed or the slow speed shaft may be the driving member, and the other the driven member. Therefore, this type of speed changing unit may be employed either as a speed reducer or speed increaser. The patent has been granted to Howard M. Edwards, New York. It carries No. 1,811,921, and is assigned to Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.

FLEXIBLE shafting adapted to carry a heavy load without material loss in friction between the parts, and characterized by simple construction and strength forms the basis of a recent patent. A distinctive idea is employed in the linking of the parts together by Bernard Granville, New York, the inventor of the shaft which has been designated as patent No. 1,817,-000. One of the objects of the invention is to provide a flexible shaft which may be enclosed and rotated in a flexible tube, without friction between the shaft and tube.

In Fig. 3, *A* shows a sectional view of the shaft; *B* is an enlarged transverse section taken on the line 2—2 of *A*, looking down; *C* shows a wide view in axial section of a part of a modified shaft adapted to resist end pressure. In the illustrations certain parts in duplicate are further identified by exponents.

A flexible shaft embodying the invention consists of a series of ring-shaper units 10, connected together by short axial pins 11, having heads with spherically curved surfaces engaging correspondingly curved surfaces in the rings. Torque is transmitted from one ring to the next through crown gears 18 and 19, formed at the ends of rings 15 and surrounding the middle parts of the connecting members.

In order to adapt the shaft for use in a tube, and to eliminate friction when it is so employed, each split ring 10 is provided with a bearing ring 50 mounted on bearing balls 51. An inner race 52 is formed in the flange 28 of the rim 27, so that, although the ring is split, the balls run on a continuous surface. Bearing rings 50 project laterally further than any other parts of the shaft, so that they alone come in contact with the inner walls of the tube in which the shaft may be placed. Therefore, when the shaft is in a tube each ring is mounted on a bearing.

To facilitate a variation in the length of the

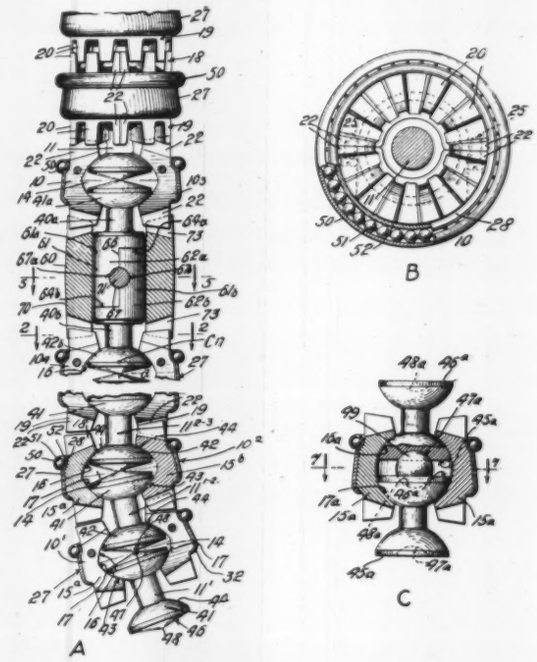


Fig. 3—Flexible shaft employing crown gears and ball bearings

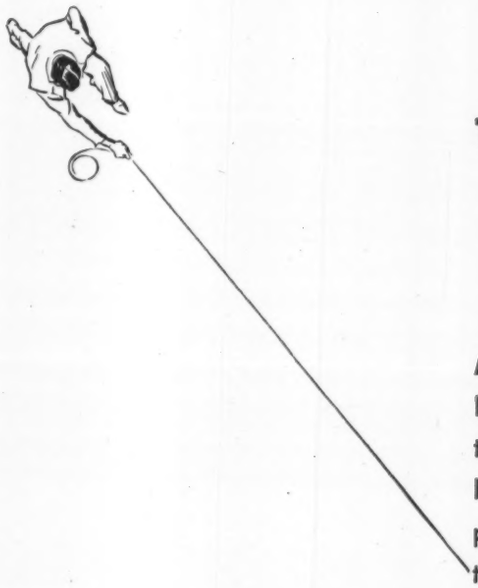
shaft without disassembling one of the split rings, the shaft may be provided at convenient intervals with couplings 60 shown in *A*.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

STAINLESS CHROMIUM ALLOY—1,809,437. Covered by this patent is the method of purifying a bath of molten metal which comprises slagging off impurities, adding ferro-chromium, injecting oxygen into the bath and adding a floatable material comprising a metallic oxide and a reducing agent that fuses off during the oxygen injection. Assigned to Stainless Steel Corp., Youngstown, O.

LABYRINTH PACKING—1,810,372. In a labyrinth packing for sealing the space between two relatively rotatable members, an annular conical packing element carried by one of the members and having a free edge extending axially toward and packing against a part of the other member by axial clearance. Assigned to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



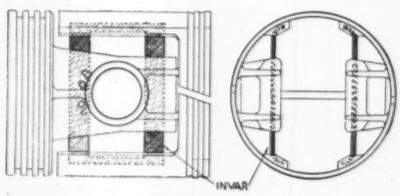
CONSTANCY!

THAT'S WHY A 100-FOOT INVAR TAPE ALWAYS MEASURES 100 FEET

Most metals won't "stay put" under varying conditions of heat and cold. However, Invar, a Nickel-iron alloy is a notable exception. Containing approximately 35% Nickel, it has a reputation for constancy...for exceptionally low expansibility. That's why a 100-ft. Invar surveyor's tape...in tropic sun or arctic cold...always measures a hundred feet.

Invar is a Nickel alloy with a scientific past and a bright future. Extensively used for scientific instruments, temperature regulating devices, etc., Invar is being adopted for machinery parts operating at high temperatures. When used with aluminum alloy pistons in automotive and aircraft engines, Invar overcomes excessive expansion and wear, prevents seizing, high oil consumption and allows ample clearance at all times between the piston and cylinder wall. In addition to low expansibility, Invar possesses these important mechanical properties: maximum stress, 78,500 to 85,000 p. s. i.; elongation, 40 to 45%; reduction of area, 60 to 65%.

Information concerning Nickel alloys of the Invar type will be gladly sent upon request.



Method of using INVAR for controlling expansion of non-ferrous alloy piston. Clearances between piston and cylinder wall as low as 0.003" are feasible with a 4" diameter piston.

THE INTERNATIONAL NICKEL COMPANY, INC.

Miners, refiners and rollers of Nickel. Sole producers of Monel Metal

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● Nickel alloyed with other metals—steel, stainless steel, cast iron, brass, bronze, aluminum, etc.—insures dependable mechanical properties and one or more of the following improvements: (1) Greater impact and fatigue strength. (2) Greater resistance to heat, corrosion and wear. (3) Better workability. (4) Improved color and appearance.

Nickel ALLOYS

PERFORMS BETTER LONGER

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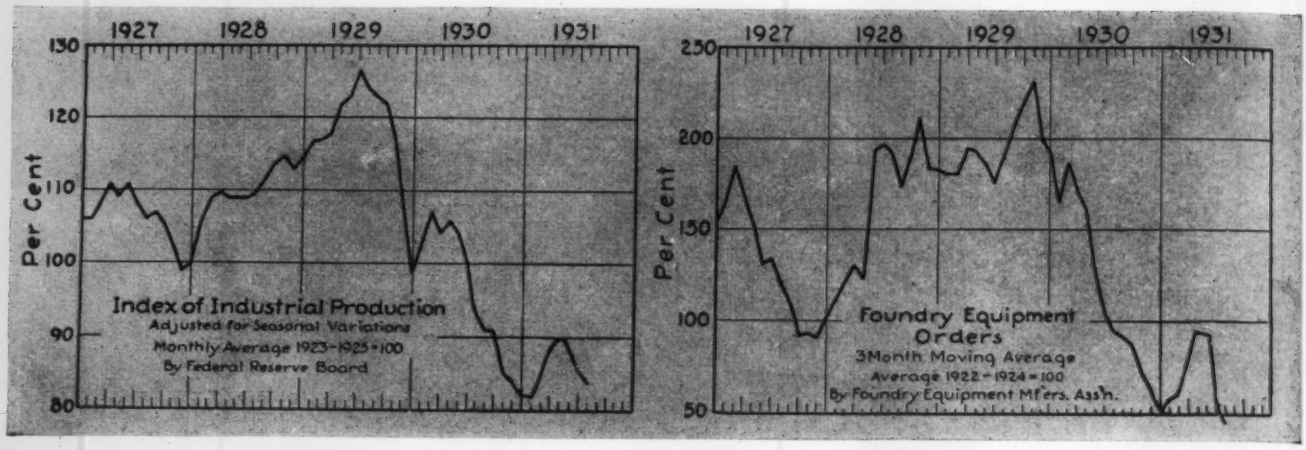
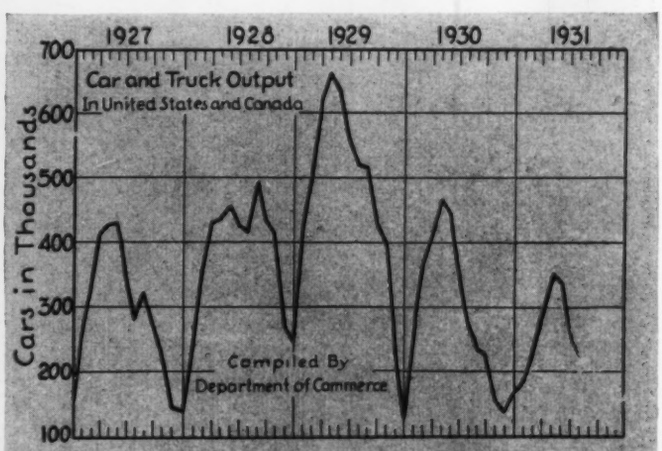


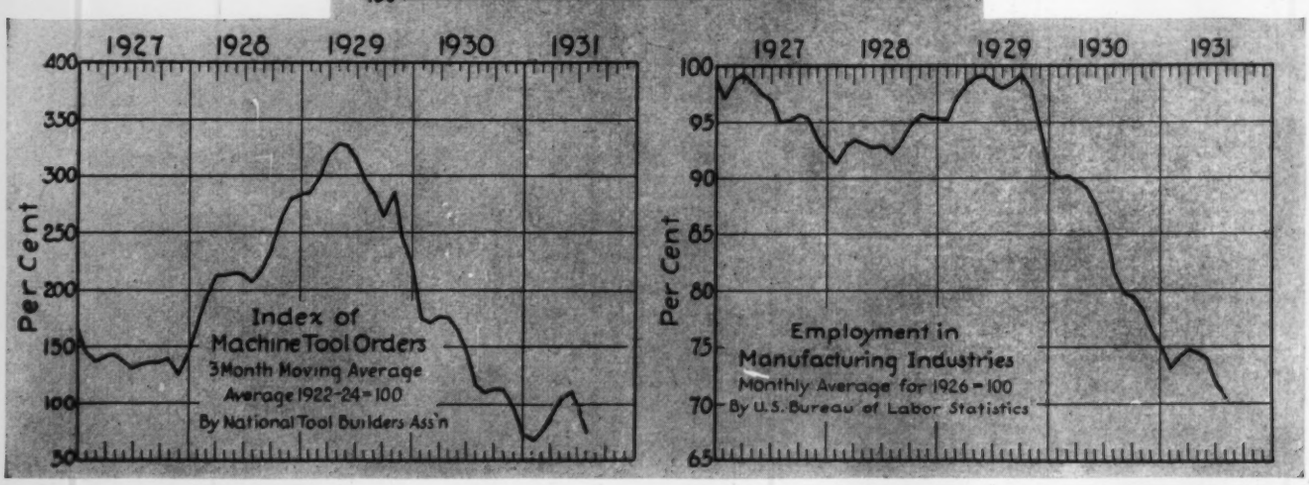
How Is Business?

LIKE a punch-drunk fighter holding onto his advantage by a display of "front," old man depression continues to intimidate industry, his blows producing more odious statistical comparisons with previous years. However, the wise boys on the ringside are beginning to ask, "What's holding him up?" and, "How long can he last?"

Among the disclosures supporting the contention that the lean years are nearly completed, is the reliable report that wear, breakage, rust and obsolescence are consuming machinery at a more rapid rate than manufacturers are turning out new equipment. The need for replacements in the automobile industry is growing daily, as the present volume of sales is not sufficient to compensate for the rate at which cars are being worn out. With these factors draining the supply reservoir filled by years of overproduction, it hardly seems possible that the present state of inactivity can continue through many more months.

The seasonal gain from the first to second quarters for this year was larger than that experienced during the rush years of 1928 and '29. The Gray Iron Institute has reported that the gain in new business recorded for July was a rather unseasonable increase and undoubtedly reflected a condition of industrial concerns being compelled to replenish their stocks to care for the normal increase in business during the next few months. In the fall, a moderate stimulus is expected with a seasonal downward trend at the end of the year.





Pennsylvania Railroad Puts 150 New Electric Locomotives On Timken Bearings

150 of the electric locomotives to be built for the Pennsylvania Railroad's New York-Washington electrification project will be equipped with Timken Bearings on all driving wheels and engine truck axles.

90 of these locomotives will be of the P-5 class, 3,750 H.P., designed for a speed of 90 miles per hour in passenger service. The other 60 will be of the L-6 class, 2,500 H.P., for freight haulage.

The selection of Timken Bearings for this important new equipment foreshadows the universal use of anti-friction bearings on all types of locomotives and railway rolling stock.

This is the largest order for anti-friction bearings ever placed by any railroad at any one time. The Timken Roller Bearing Co., Canton, Ohio.

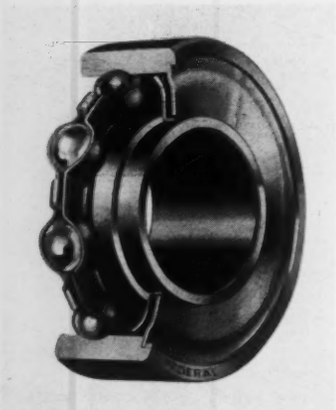
TIMKEN *Tapered Roller* **BEARINGS**

NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Bearing Has No Frictional Contacts

NO FRICTIONAL contact between rotating parts is present in the new Vacuum-Seal bearing, an all metal unit introduced by Federal Bearings Co., Poughkeepsie, N. Y. The efficiency of the seal in the bearing, shown herewith, is mechanical. The inner impeller and outer seal provide a space in the nature of a vacuum pocket, preventing suction of foreign matter into the bearing. The impeller continually throws grease into the races and upon the balls where it is required, and the vacuum retains the grease.



Impeller throws grease on the balls, pocket prevents its escape, in recently introduced sealed bearing

Standard S. A. E. dimensions always are maintained, consequently no distortion is developed in mounting. There are no loose parts. The impeller is pressed securely on the inner race ring, and the outer seal is spun into a recess in the outer ring. All sealing agents are eliminated, thus obviating the possibility of extraneous material getting into the bearing.

Live Rubber Protects New Plug

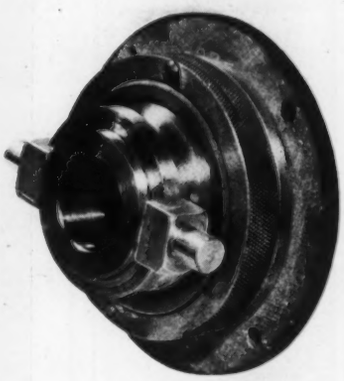
A NEW line of three-wire rubber Twist-Lock devices has been introduced by Harvey Hubbell Inc., Bridgeport, Conn. The live rubber adds an unbreakable feature to the plugs, connectors and bodies for industrial use and for all portable electrical equipment and devices. All of the devices are polarized properly and grounded to protect the user against the dangers of shock and fire hazard. The blades, when inserted in the receptacle or connector body slots, are locked in place by a slight turn or disconnected by a slight turn in the opposite direction.

Three wire device is protected against damage by live rubber construction

The security of a direct electrical connection and the flexibility of a separable connection are provided by this feature. The device, shown herewith, has a rating of 20 amperes, 250 volts.

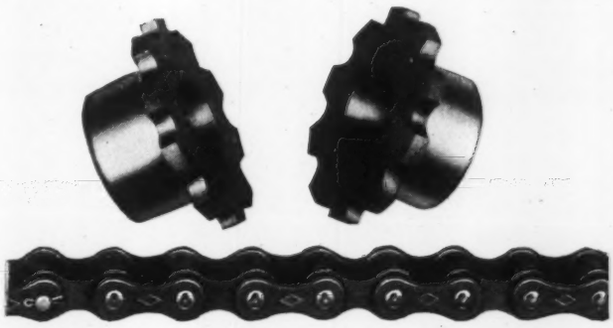
Clutch Resists Centrifugal Forces

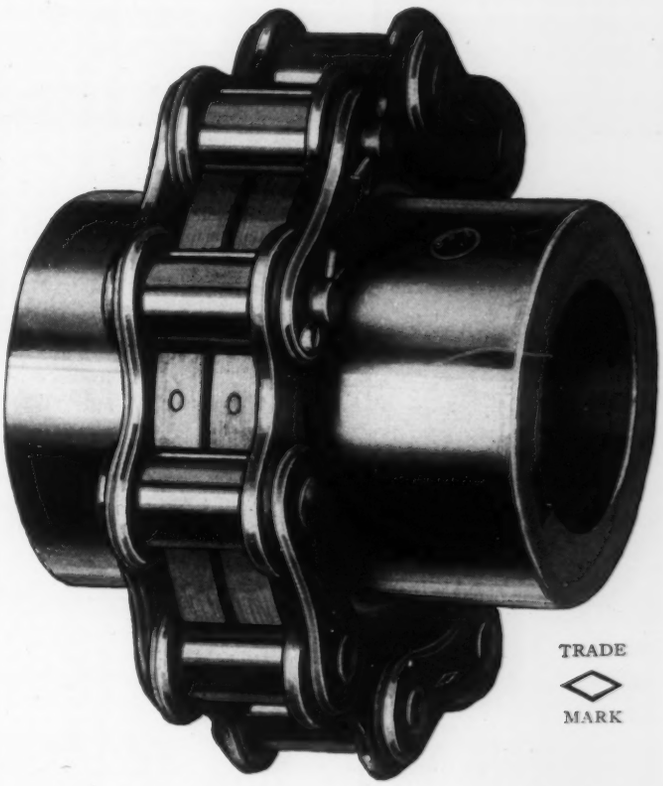
DESIGNED for use in small high speed installations, where a compact unit whose operating mechanism is not affected by centrifugal force when it is disengaged is required, the new type "G" clutch introduced by Twin Disc Clutch Co., Racine, Wis., is especially applicable with fractional horsepower motors, power lawn mowers, washing machines, power sprayers and other



Especially applicable with fractional horsepower motors, new clutch makes a compact unit

This SIMPLE Flexible Coupling . . .





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The DIAMOND-CLARK FLEXIBLE COUPLING

Simple Construction

Only three parts—two sprockets and a length of Diamond Roller Chain.

Sturdiness

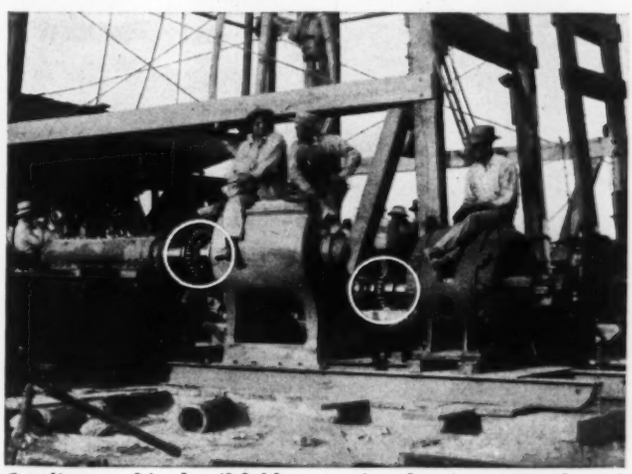
Nothing to get out of order.
All parts are rugged. There are no intricate or delicate elements to get out of order or break in service. Driving parts are at the greatest possible radius, and the load is equally divided which reduces stresses to a minimum.

All Metal Construction

Flexibility is due to the design and not to the use of flexible materials, which when employed, usually require frequent replacement in service.

Quick Change of Relation of Driving and Driven Machines

If desired, the Diamond Chain can be removed and one unit moved forward or backward a part of a revolution with respect to the other. The chain is then put on and connected and the units are ready to run in their new angular relation.



Couplings used in the oil field, connecting electric motor and speed reducer and connecting speed reducer and duplex slush pump.

Ease of Installation

Couplings can be installed, aligned, and connected quickly without the use of special tools.

Ease of Disconnection

Separating the machines connected by the coupling is easily accomplished in a few moments by taking out the chain connecting link and lifting the chain off the sprockets. Because of this feature, these couplings are frequently employed even when no flexibility is required, because the connected units may be separated so easily and quickly.

Made in a wide range of sizes for all ordinary load conditions and to accommodate shafts up to 11 inches in diameter.

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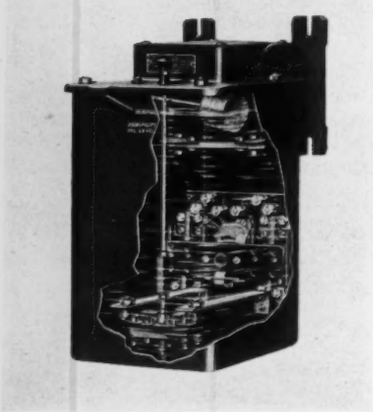
(A-4245)

small industrial and agricultural machinery. The component parts of the clutch, shown herewith, are of the simplest form, and are designed to interlock in such a manner that no cotter pins or similar fastenings are required.

The levers are housed within the nut structure and are operated by a cone of internal form. Adjustment is simple and consists of screwing or unscrewing an adjusting ring, clamped by a screw having a coin slot. The levers and this screw are of heat treated nickel steel, and the clamping plate, which may be bolted to the driving member, is driven by round pins or it may have gear teeth cut in the periphery for driving from an internal gear ring. The clutch is made also for use in oil spray, using two bronze disks of the lug type and one steel disk in place of the simple dry plate.

Starter Contacts Are Immersed in Oil

DISTINGUISHED from similar explosion-proof equipment by the immersion in oil of its thermal overload mechanism, a new across-the-line automatic starter for alternating current squirrel cage induction motors has been announced by Cutler-Hammer Inc., Milwaukee. This mechanism differs from the usual immersed oil dashpot relay and three-pole magnetic contactor in that a newly designed thermal overload device is used with the contactor.



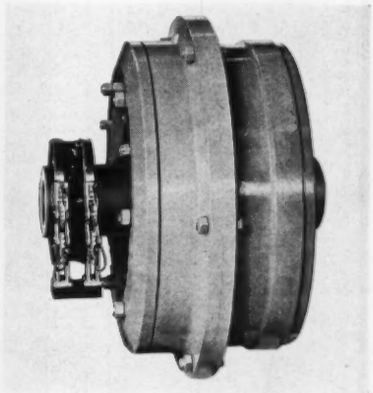
Thermal overload mechanism of explosion-proof automatic starter is immersed in oil

The contacts of this new starter, shown herewith, open under a 6-inch head of oil. A special provision is made for bringing all incoming wires to the terminals below the oil level. A float-operated oil indicator shows the oil level. Threaded conduit openings and a compound filled junction box are included.

Being completely oil immersed, the starter is corrosion-resisting and therefore suitable for chemical plants and cement mills. It is designed in keeping with the latest requirements of the Underwriters laboratories for class 1, group D, hazardous locations.

Magnetic Clutch Is of Unusual Design

EXTREMELY simple construction, operation and adjustment mark a new multiple disk magnetic clutch, radically different in design and operation from all other types, manufactured by Magnetic Mfg. Co., Milwaukee. The clutch does not drive through spring plate or pins; armature and field do not move relative to each other; and the entire unit has virtually no moving parts such as toggles, cams, rollers, or yokes, to get out of order or cause trouble. There is practically only one wearing surface, the friction lining, and a single adjustment can compensate for wear on this lining.



Less space is required for installation of multiple disk magnetic clutch of improved design

Other advantages of this new Stearns clutch are: reduced size, less space required for installation; small diameter clutches take care of heavy loads; greater friction area—multiple disks provide ample friction area at low pressure; and low cost both for installation and maintenance. The accompanying illustration shows the clutch assembled.

Announces Electric Steam Generators

ELECTRIC steam generators that can be built into the device to be heated, or installed as a separate unit have been announced by General Electric Co., Schenectady, N. Y. The new line, for application where steam is needed but is not available in sufficient quantities or at suitable pressure, includes two pressure ratings—100 and 200 pounds—in various sizes and electrical ratings.

The standard unit consists of a suitable steel container in which one or more helicoil sheath-wire immersion heaters (depending upon the capacity required) are inserted. The generator is provided with standard boiler fittings, including a safety valve, steam gage, water column, blow valve, steam valve, etc. A typical control equipment consists of a magnetic switch and an automatic pressure governor which, when operated in conjunction with a low-water alarm, automatic heat-shut-off switch and some device for

The workman, the machine, and its motor drive—three great investments. Protect them with G-E control

G-E CONTROL

PROTECTS THREE GREAT INVESTMENTS . . . MEN — MACHINES — MOTORS

GIVE the machines you are designing, or redesigning, the full protection afforded by dependable G-E control. ¶ Guard men against unexpected starting of machinery. For example, where power has failed and may come on without warning. ¶ Guard machines against "humps", "hard spots", and the like in the work being machined, and against undue strains accidentally, or intentionally, imposed by workmen. ¶ Guard motors against excessive overload, reversed current, undervoltage, and the like. ¶ In the complete line of G-E control equipment there are devices that meet every control need of modern machines — adequately and dependably. Look into the many advantages of protection, performance, and appearance inherent in G-E control. The nearest G-E office will be glad to coöperate.

CR2940 push-button station—a representative G-E control device

GENERAL ELECTRIC CONTROL

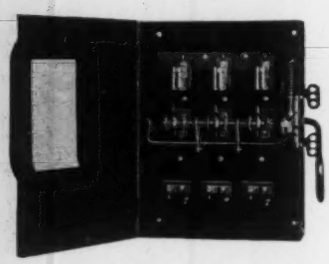
301-82

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

automatically feeding additional water to the generator, makes the equipment completely automatic in operation and obviates any necessity of supervision except for the periodic inspection ordinarily given to electrical apparatus.

Develops Improved Safety Switches

SAFETY switches manufactured by Square D Co., Detroit, have been redesigned to incorporate four major improvements. The interlock mechanism of the switch, shown herewith, has been simplified with fewer operating parts and is more compact, giving ample wiring space on both sides as well as at the top and bottom. The interlock is controlled by a key, but it may be disabled with a screwdriver slipped into the slot for operation of the switch when the door is



Improved safety switch has better operating characteristics

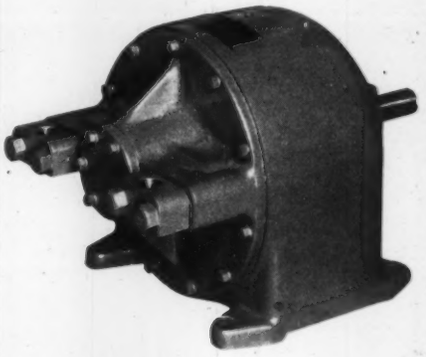
open. The door can be opened only through the use of a key when the switch is closed.

Positive pressure fuse clips, made of high conductivity copper with steel spring reinforcements are now standard in all sizes. This fuse clip grips the fuse firmly under all conditions and insures long contact life as well as reducing the heating at this point. The dust shields have been made wider, longer and stronger. The fourth improvement is the addition of a slotted hexagon nut on switches of 100-ampere capacity or less. This enables the electrician to use a screwdriver, wrench or pliers. Such major features as the high breaking speed and ability to rupture the current in 1/100 second are retained in the new design.

New Motor Has Smooth Rotary Motion

AN IDEAL variable speed transmission may be obtained with the new type RQ-2 motor recently brought out by Oilgear Co., Milwaukee, when these units are used in combination with a variable delivery pump. The motor, shown in the accompanying illustration, is of the constant displacement type. The complete units can be applied to conveyors, paper mill drives, and other machinery where smooth rotary motion and variable speed are essential.

A series of speed ratios practically independent of variations in load are available with this type of transmission. Any source of power can be used to drive the pump, while the motor shaft speed can be varied from zero to maximum, at



Smooth rotary motion is obtainable with new constant displacement type motor

all times under the control of a single operating lever. Smooth rotary motion and positive variable speed within the rated range of the transmission is obtained with this new multiple piston motor.

Locknuts Require No Additional Parts

ONE-PIECE reusable locknuts which require no additional parts and are tapped to standard thread and made to commercial tolerances have been brought out by American Marsden Co., Jersey City, N. J. The nut, shown herewith, is in effect a standard nut, having a slotted head and a dished or recessed bottom which forms a

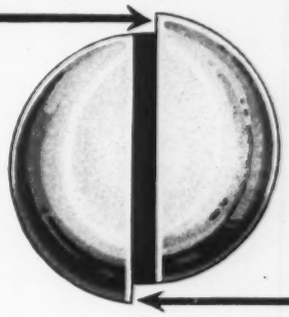
No additional parts are required for these locknuts tapped for standard threads

continuous outer bearing surface. It may be obtained in special sizes, either shallow or deep, or in threads to meet specialized requirements.

The locknut when tightened home with a wrench takes up the clearance between the threads of nut and bolt, which clearance is necessary for initial threading of nut on bolt, thereby developing a definite frictional contact on both sides of each thread. Only the outer continuous bearing surface of bottom of nut actually makes contact with seating surface, hence, when

SHAKEPROOF
Self Locking Set Screw

The Off-Set Does It!



TOP VIEW

This exaggerated view shows the off-set that insures positive locking.

THE new Shakeproof Self Locking Set Screw does something that no other set screw can do. It *locks itself* and that means it will not loosen, even under the most intense vibration.

The off-set of the slotted end of the screw is the simple secret that makes this amazing performance possible. This off-set creates a spring tension on all threads—producing a positive lock that requires no extra operations to make it secure.

Try this new Set Screw on your own product—give it the hardest possible tests you can devise. Then, you will know how the Shakeproof Self Locking principle keeps connections tight and thus improves performance.

Free trial samples are ready. Mail the coupon for a supply today!

U. S. Patent Nos.
1,764,168
1,767,287
Other patents pending.

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Lock Washer Company

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Pittsburgh Schenectady Cleveland Detroit
Toledo Cincinnati Birmingham, Ala.
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2551 N. Keeler Ave., Chicago, Ill.
Gentlemen: We want to test your new Self Locking Set Screw. Please send us samples as indicated.

Style of Point..... *Size*.....

Firm Name.....

Address.....

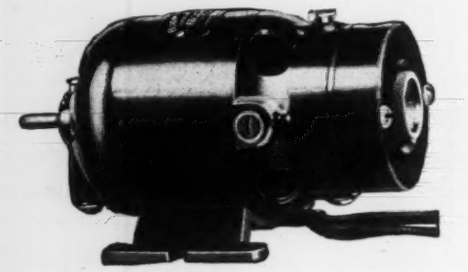
City..... *State*.....

By..... *Title*.....

wrench load is applied, the load is transmitted as a distributed load over the whole of the bearing surface, resulting in the slightly throwing inward and downward of the segmental portions formed in the head of the nut due to the slotting, thereby making perfect thread contact over the area affected. The nut has particular resistive powers to stripping and bursting, and is said to be stronger than an ordinary nut.

Motors Are Equipped With Governors

SERIES wound motors equipped with improved electric governors have been developed by Bodine Electric Co., Chicago, and the complete new line is now being manufactured. This new governor has shown itself to be reliable on such applications as talking motion picture equipment, electric pyrometer, control drives, traffic signal control, etc. Although most frequently applied to the series wound motor, it also may be used with the shaded pole type motors. Accuracy approaching clock time and rapid acceleration are features of this new unit. It is available in both fixed speed (adjustable) types or variable speed (while running) types. A series wound motor with the governor attached is shown herewith.



Electric governor controls operation of series wound motors

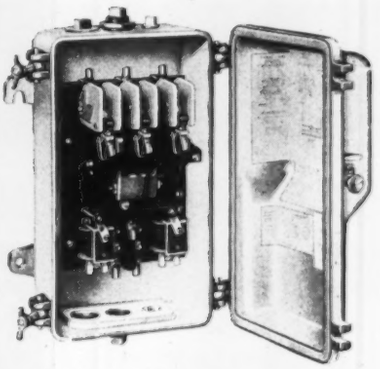
Packing Withstands Heavy Loads

TWO closely related packing materials, originating in Europe, in successful use for some time have been taken over by the A. & E. Co., Chicago. One of these materials, known as "Aeco," is a plastic self-forming packing composed of porous all-metallic kernels, saturated with non-drying lubricants. The packing, it is claimed, will not dry out or harden, and owing to its plasticity it will accommodate itself to expansion, contraction and vibration. Being plastic, it can be made to fit any size of stuffing box. It is molded in several grades into cakes which, when broken up and placed in any stuffing box, form into a ring bearing around the rod when the gland is tightened.

As a packing material for bolted flanges to replace ready-made gaskets "Plasket" also is made in a number of grades. The uses designated are much the same as for the packing. Practically the same material, under the name of "Pipease," is supplied for threaded joints. Resembling a heavy putty-like mass, these materials are applied in a thin layer with a putty knife to the sealing surface. As in the case of the packing, it is said that "Plasket" will function under vibration and will withstand expansion and contraction of the adjacent parts. It is not affected by any of the substances with which it comes in contact, and because the material remains plastic indefinitely, the joint can be demounted easily at any time. These products come in cans of 1½ to 10 lb., or in larger lots in drums.

Starting Switches Are Splashproof

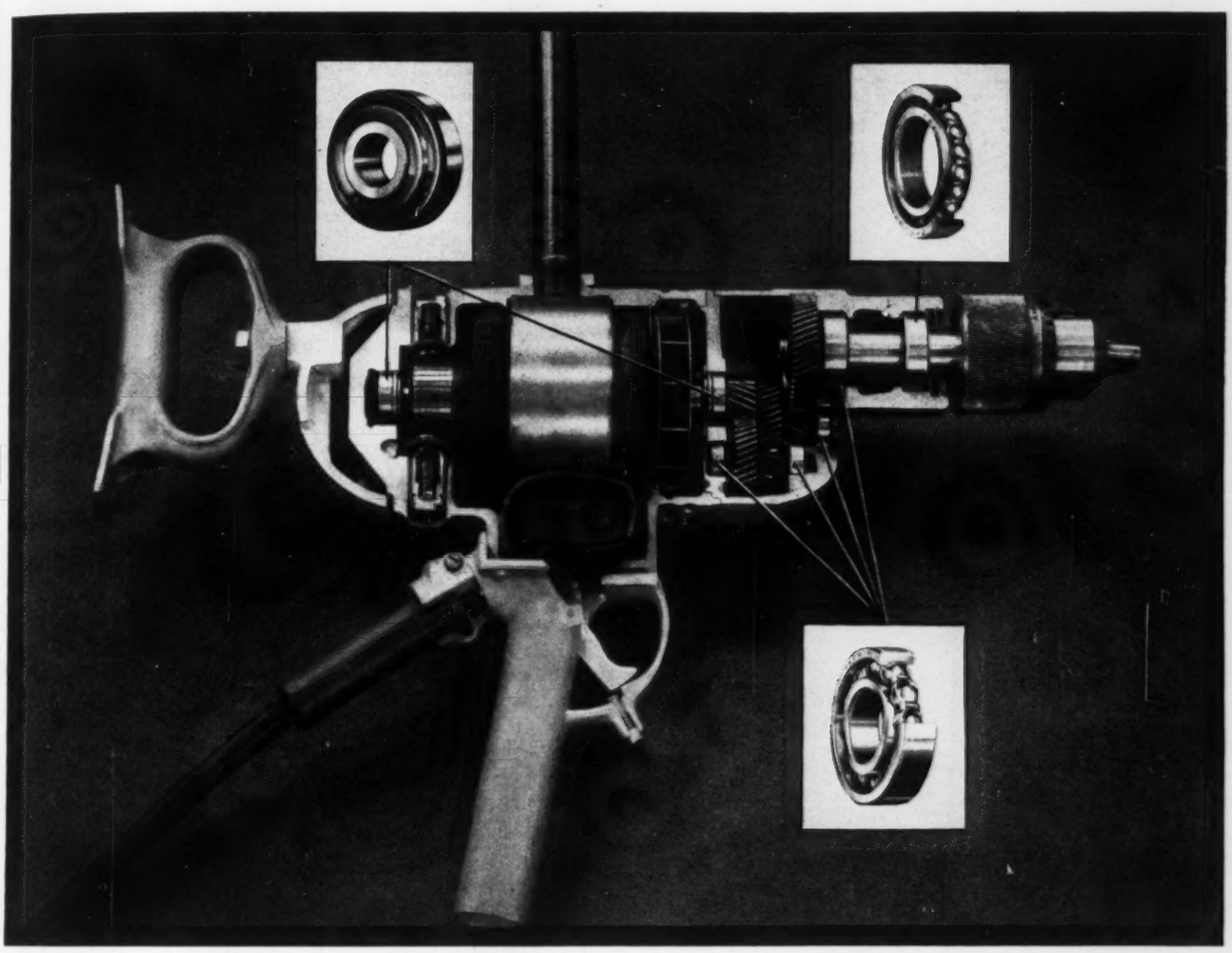
ACROSS-THE-LINE starting switches for use in laundries, packing plants, creameries, rayon plants, and other places where a splashproof starter is required, are announced by Allen-Bradley Co., Milwaukee. The new starters, shown herewith, are rated for squirrel-cage motors up to and including 100 horsepower, 200 volts, and 200 horsepower, 440-550 volts. On slip-ring motors they serve to control the primary circuit up to and including the maximum rating listed for squirrel-cage motors. If the thermal relay reset button is omitted from the side of the cabinet, this starter is entirely watertight.



Protection against splash is provided by new across-the-line starting switches

Introduces New Babbitt Metal

A NEW lead base product for use as a babbitt metal, said to be an antifriction metal of outstanding superiority, has been developed by Bunting Brass & Bronze Co., Toledo, O. This product, offered for all operations served by a lead base babbitt, is offered in boxes of 10 five-pound bars so cast that they are divisible in smaller portions. It is a close grained material which assures smooth wearing by giving a glassy



"Every bearing a ball bearing" means longer life for Wappat Drills

PERFORMANCE, in any machine or mechanism, can be no better than the bearings. Small wonder, therefore, that Wappat directs such emphatic attention to the sealed, deep-grooved ball bearings on armature shafts; to the combination radial and thrust ball bearings on the spindle. The fact is, that Wappat uses as many as seven Fafnir Ball Bearings per drill.

Armature shafts rotate freely in Fafnir Felt Seal Ball Bearings which are packed in grease at the time of manufacture, and never require lubrication.

Fafnirs of the angular-contact design take the thrust load. And ge urs as well as shafts in various Wappat tools are kept in perfect alignment by the type of Fafnir Ball Bearing precisely suited to the need.

Fafnir makes the most complete line of ball bearings in America. That is one of the reasons so many manufacturers make full use of Fafnir Ball Bearings in machines of every description. And important to both the builder and user is the fact that Fafnirs are of such an unvarying high quality that lasting alignment for the moving members they support is assured.

Complete data, including load ratings, load calculations, suggested uses, etc., are incorporated in the Fafnir Engineering Data Book. You will find this information very useful. A copy is yours for the asking.

FAFNIR

THE FAFNIR BEARING CO., NEW BRITAIN, CONN.

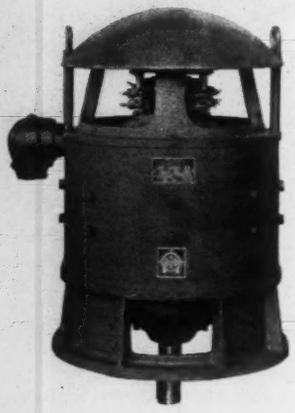
Atlanta Chicago Cincinnati Cleveland Dallas Detroit
Los Angeles Milwaukee Newark New York Philadelphia

FAFNIR BALL BEARINGS

polish to slightly scored or old shafts. Should dust or grit get into the bearing, it sinks into the metal, clearing the face of the shaft.

Designs New Vertical Motors

DIRECT current motors for vertical operation in sizes up to 50 horsepower, 1150 revolutions per minute have been announced by Reliance Electric & Engineering Co., Cleveland. These motors, shown in the accompanying illustration, are provided with a ring base for mounting and a drip cover to protect them from falling



Vertical motors can be mounted directly to machine to be driven and will appear as an integral part

dirt and chips and from dripping water, oil, or injurious solutions.

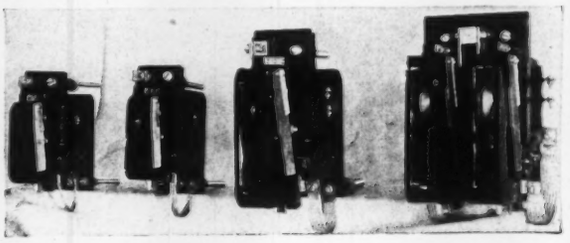
Where it is desirable, the motor can be mounted without the ring base directly to the machine being driven and it will appear as an integral part of that machine. Amply large bearings are used to take up the thrust load or weight of the armature. Two heavy eye-bolts are provided to make handling easier. In all other ways the construction is the same as the direct current, heavy-duty motor manufactured by the company for horizontal operation.

Heavy Duty Contactors Are Announced

A RADICALLY new heavy duty contactor for steel mill, crane and general purpose direct current magnetic controllers has been developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These contactors, shown herewith, are of unique construction, are compact and may be mounted closely together since all parts are removed from the front for replacement.

An effective rupturing capacity is obtained by high speed operation and an especially designed arc box and horns along which high flux blowout forces the arc. The fast opening of contacts assists in the rapid extinction of the arc, thus prolonging the life of contact tips, arc box and other adjacent parts.

The shunt, suspended from the center of rotation of the armature, has practically unlimited life. The bearing pins of the armature and contact arm are of nitrided alloy steel with a sur-

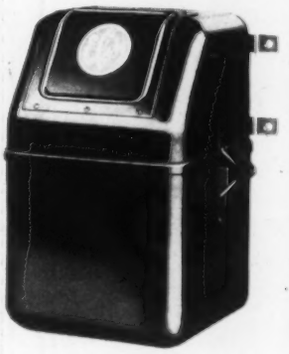


Contactors for direct current magnetic controllers are of compact construction

face twice as hard as the hardest commercial steel used in springs. These features together with low bearing pressure and reduction of vibration due to injurious bouncing of contacts on opening or closing prolongs the life of the contactor parts.

Motor Starters Have High Efficiency

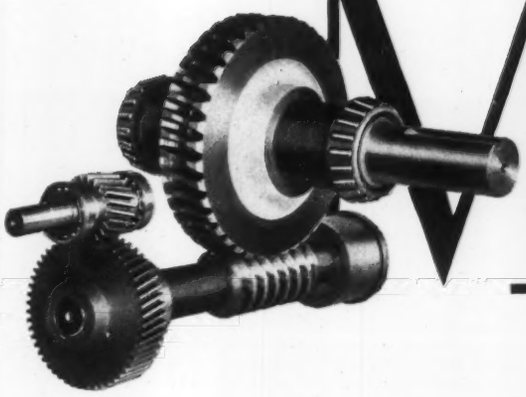
WITH particular attention given to produce a starter exceptionally quiet and highly efficient in operation, the Electric Controller & Mfg. Co., Cleveland, has developed the No. 2 type ZO across-the-line motor starter. The starter, shown herewith, is a self-contained unit, totally enclosed in a heavy pressed steel case



High efficiency and exceptional quiet feature across-the-line motor starter

with oil-immersed main and control circuit contacts and vapor-proof overload relays. These features of design make it perfectly safe for operation in adverse atmospheric conditions.

This larger counterpart of the previously introduced No. 1 type ZO attains its efficiency of operation by the use of a 3-pole E-shaped magnet, on the center pole of which is mounted the moisture-proof operating coil. The upper pole



More SATISFACTORY

. . . more ECONOMICAL

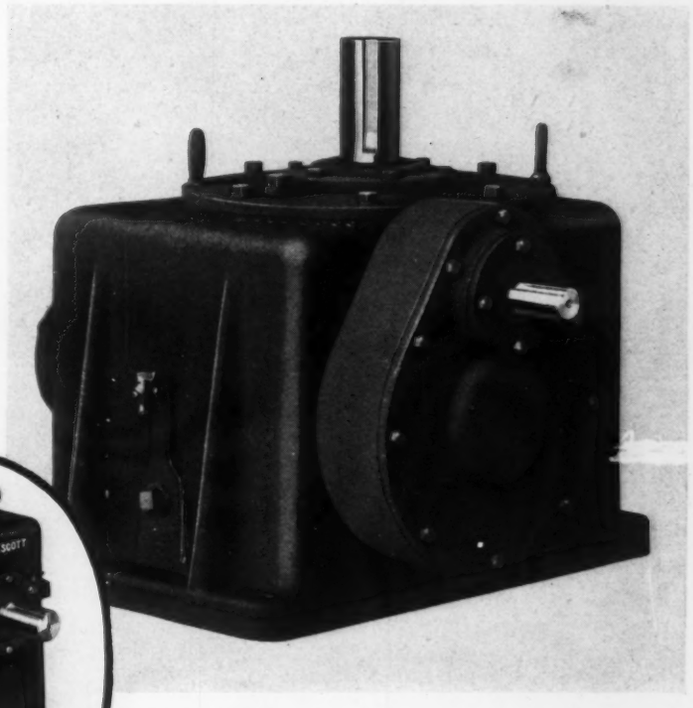
FOR

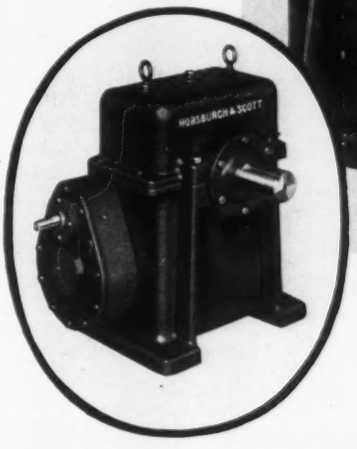
RIGHT-ANGLE HIGH RATIO DRIVES

THE reduction elements in the new Horsburgh & Scott Worm Helical Speed Reducers are a pair of silent helical gears and a standard worm and gear — all enclosed in an oil-tight housing. The result is a unit of extreme compactness and high efficiency, ideal for ratios higher than those available in single-reduction worm gear units.

These units are built in two types, Type WBH (gear shaft horizontal) and Type WVH (gear shaft vertical) in ratios up to 640 to 1. Anti-friction bearings throughout — all gears and bearings operate in a bath of oil within the housing.

The new 128 page Horsburgh & Scott Catalog describes these units and Worm Gear, Heli-Spur and Herringbone Speed Reducers of an exceptionally complete line. Send for your copy of this valuable reference book.





Our engineers will gladly cooperate with you in the selection of Speed Reducers to meet your conditions of service.

THE HORSBURGH & SCOTT CO.

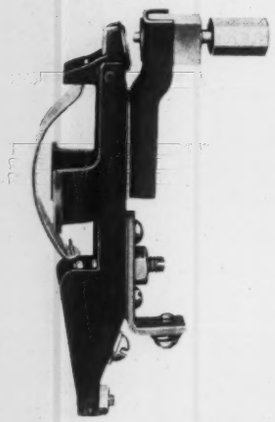
CLEVELAND, U. S. A.

SPEED REDUCERS AND GEARS

of this magnet is half shaded, the middle pole not shaded and the lower pole completely shaded. This design eliminates chattering and hum and produces a uniform pull on the armature due to two additional fluxes of different phase angles superimposed upon and out of phase with the main flux produced by the line current.

Thermostatic Switch Has Few Parts

ONLY two moving parts are employed in a new positive snap action 1000 watt alternating current capacity thermostatic switch announced by Robbins & Myers Inc., Springfield, O. The switch, designed especially for thermostatically controlled heating appliances, maintains desired temperature over a total heat range



Simplicity, compactness and long life mark positive snap action thermostatic switch which employs only two moving parts

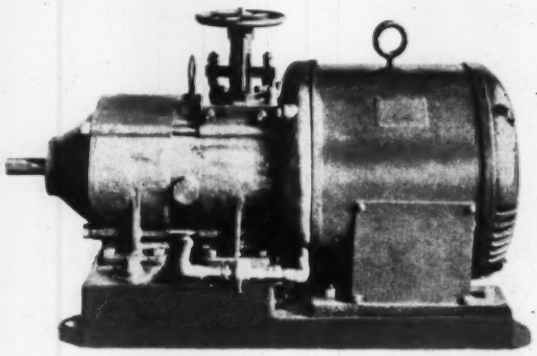
from atmospheric temperature to 525 degrees Fahr. with a maximum variation of 5 degrees. A special low temperature type thermostatic snap switch to maintain temperature with a differential of but 2 degrees also is being placed on the market.

Other noteworthy features of this switch, shown herewith, are simplicity, compactness, and long life. It occupies from 1/3 to ½ less space than the ordinary switch. The circuit breaking spring is of special steel test-developed for maximum endurance. The switch is designed for easy application and can be installed as part of the final assembly job. It can be made either to open or close with temperature increase.

Infinite Speed Variation Is Provided

FULL rated torque can be developed at any speed from 1 to 1000 R. P. M. either forward or reverse with a small, compact 5-horsepower electro-hydraulic transmission developed by American Engineering Co., Philadelphia. Since the torque is constant the horsepower output varies with the speed of the hydraulic motor. At maximum speed the transmission will develop 5 horsepower continuously.

In the accompanying illustration, the hydraulic motor is at the left, hydraulic pump in the center, and electric motor at the right, all mounted on a single bed plate reservoir which contains the oil used in the system. The hydraulic pump and motor are of the Hele-Shaw



Output of electro-hydraulic transmission varies with speed of hydraulic motor

design and are similar in construction except that the motor has a fixed stroke while the stroke of the pump may be varied from minimum to maximum.

The electric motor drives the pump shaft at a constant speed. Oil is delivered by the pump to the hydraulic motor at a rate corresponding to the stroke of the pump, regulated by the hand wheel or other suitable device. Oil in the system passes through finned tubing surrounding a fan fitted to the pump end of the electric motor shaft, consequently its temperature is maintained at a degree commensurate with efficient operation.

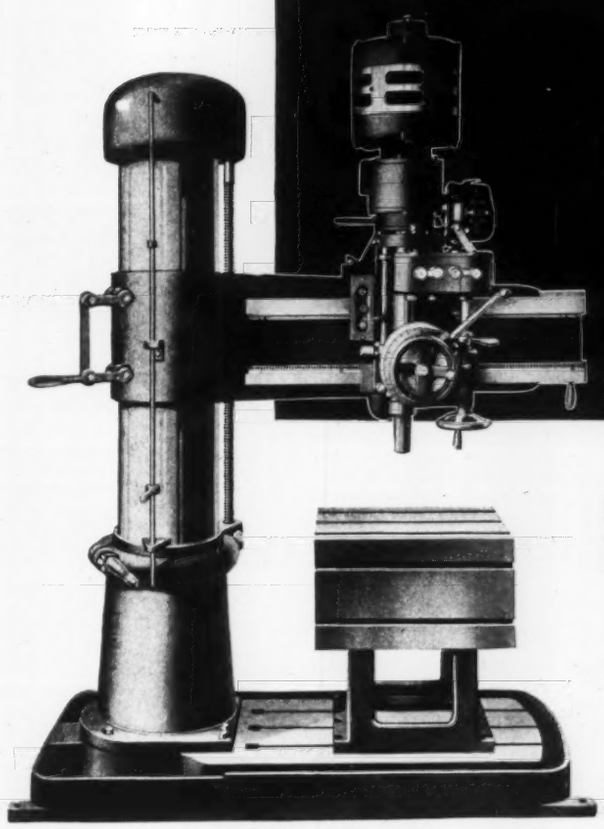
Switch Is Completely Protected

ACROSS-THE-LINE starting, thermal overload protection, and small size is provided by the new float operated starting switch announced by Cutler-Hammer Inc., Milwaukee. The switch, shown herewith, is especially applicable for small alternating and direct current motors on cellar drains, sump pumps, open tanks and similar uses. For larger motors, this same device can be provided without overload protection so it can be used as a master switch in the control circuit of a separate automatic starter.

This is a single pole starter with double break, silver contacts to assure continuous current carrying capacity. Contact mechanism is quick make and break. The operating lever and shaft are reversible in the case and the operating lever can be shifted to any angular position of the shaft, so either tank or sump operation

LOUIS ALLIS

Multi-Speed Motor



Radial Drill equipped with Louis Allis 4-speed motor. (Manufacturer's name on request).

Provides

Speed Flexibility with Instantaneous Control

•

Applies

Power Direct to Spindle

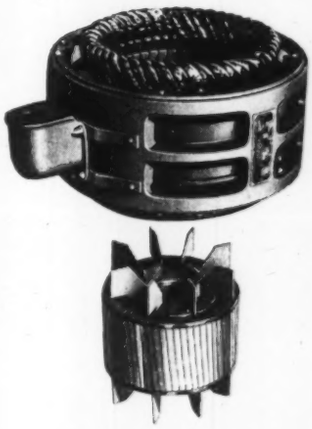
•

Eliminates

Speed-Changing Gears

By equipping this new radial drill with a Louis Allis 4-speed motor, another machine builder has created definite *operating* and *sales* advantages through *modern* motor application.

In the words of the manufacturer, "The 4-speed motor (Louis Allis) offers many advantages in design and operation... the spindle is centrally aligned and driven directly from the motor, at high speeds, without gearing. This naturally provides a more sensitive operation as well as lighter weight and simple construction of the spindle head. Drum control... gives a convenient and instantaneous change of speeds. Pushbutton control... reverses spindle rotation faster than any hand lever mechanism. A back gear... provides 4 additional speeds for heavier cuts (a total of 8 spindle speeds 85 to 1750 r.p.m.)"



Frame type shaftless 4-speed constant horsepower motor as furnished for radial drill shown above. Motor rating: 2 h.p. 1750/1160/860/560 r.p.m.

Louis Allis "Custom-Built" motors, widely used on modern production machines, can help make your machines more efficient, simple, and *saleable*. Consult Louis Allis engineers when you are designing new machines or redesigning old ones.

Write for bulletins on L.A. "Custom-Built" Motors.

Prompt Deliveries. Nation-Wide Service.

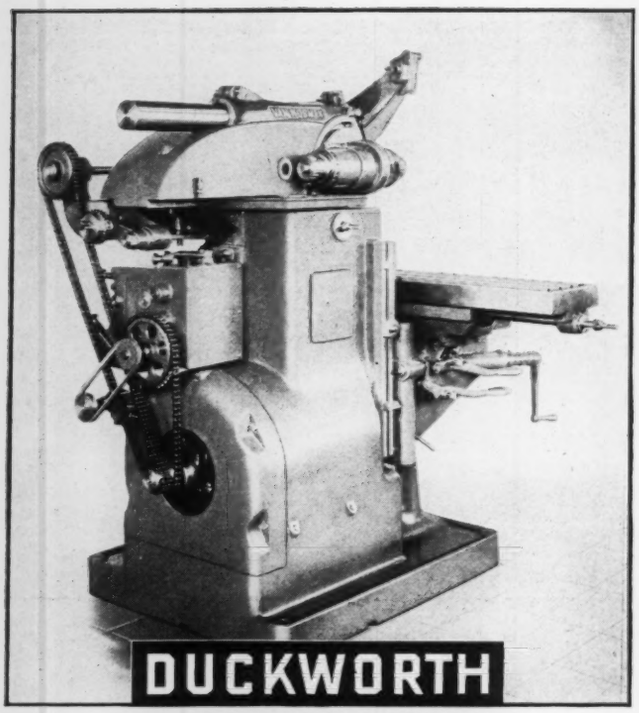
LOUIS ALLIS

"CUSTOM-BUILT" *Electric* MOTORS

THE LOUIS ALLIS COMPANY

MILWAUKEE, WIS.

Motor Specialists Since 1901 *Offices in Principal Cities*



DUCKWORTH
DRIVES FOR
MACHINE TOOLS

Duckworth Roller Chain Drives are used on this new milling machine because the manufacturer found them best from the angles of quietness, efficiency, simplicity and first cost. He also found that Duckworth design and methods of manufacture meant lower maintenance cost.

* * * * * * *

The example shown is particularly interesting as it illustrates the practical application of several roller chain drives operating directly from one motor shaft—proper use of multiple and single strand chain—proper location of idler sprocket on exceptionally long center distance.

Duckworth Chains are equally suitable for other machine tool applications. Our engineers will be glad to offer advice.

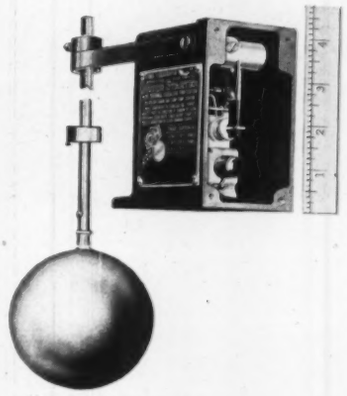
Baldwin - Duckworth Single Strand and Compound Roller Chains and Sprockets are available for drives up to 75 horsepower. ***Write for our new catalog.***

BALDWIN-DUCKWORTH CHAIN CORPORATION
Baldwin Division, Worcester, Mass.
Duckworth Division, Springfield, Mass.

BALDWIN
DUCKWORTH

can be obtained with the starter mounted in any position.

The thermal overload relay protects the motor from burnout and prevents unnecessary blowing of fuses. It is free tripping—the switch



Float operated starting switch provides thermal overload protection

cannot be held closed on an overload. When the overload trips, it is necessary for someone to go to the switch and return the operating lever to the full "off" position to reset the overload.

Motors May Be Mounted Vertically

DUE to the construction of the end brackets of the types N-5 and N-3 motors manufactured by Bodine Electric Co., Chicago, they may be provided in vertical or flange mounted models

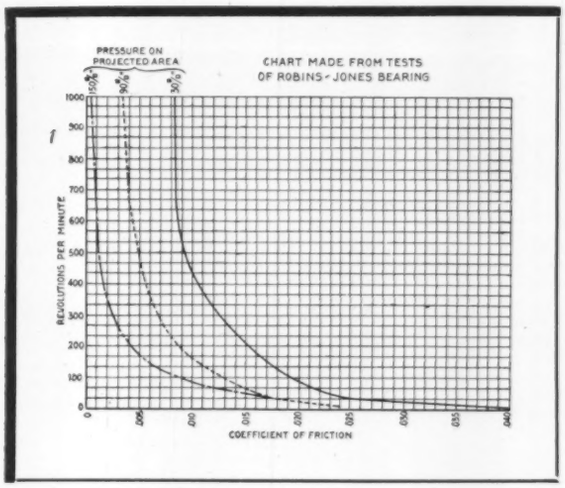
Construction of end brackets on wool-packed bearing motor permits assembly into vertical or flange mounted models

to meet any specified requirement. One of the motors with vertical mounting is shown in the accompanying illustration. Umbrella covers are optional on these installations.

Develops Manganese Steel Welding Rod

WHEN melted in the atmosphere and applied to ferrous metal articles, the new welding rod brought out by American Manganese Steel

A Bearing that Rates High in the Anti-Friction Class


PRESSURE ON PROJECTED AREA
CHART MADE FROM TESTS OF ROBINS-JONES BEARING
REVOLUTIONS PER MINUTE
COEFFICIENT OF FRICTION

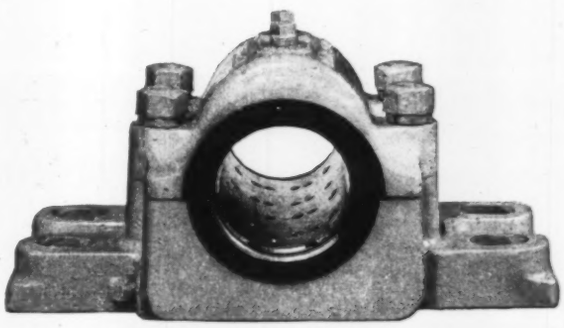
. . . but with costs much nearer those of plain bearings

IF THE principal requirement of anti-friction bearings is absence of friction, the Robins-Jones Bearing is most certainly in that class.

The accompanying chart shows several friction curves made under varying load conditions and speeds. The results obtained compare very favorably with those from ball or roller bearings.

And since the cost is considerably less than for ball or roller bearings, the economy of this bearing is not confined to actual operations. There is substantial economy in the initial investment.

Machinery manufacturers looking for ways and means to lower the cost of getting out their machines and at, the same time, improve and simplify the bearings, will do well to investigate this Robins-Jones Bearing.



ROBINS-JONES BEARINGS

Features *of the* Robins-Jones Bearing

[1]Low Coefficient of Friction . . . [2]Sustained, Complete and Economical Oil Lubrication . . . [3]Can Be Run at High Speeds . . . [4]Withstands High Pressures . . Withstands Pressure from any Direction . . . Starts Easily . . . Split Bearings, Easily Installed. . . [5]No Leakage of Oil . . . Shaft Rotation Can Be Reversed . . . Any Position of Shaft . . . Moderate Cost.

[1]See Machine Design—April [2]Machine Design—May [3]Machine Design—June [4]Machine Design—July [5]Machine Design—August.

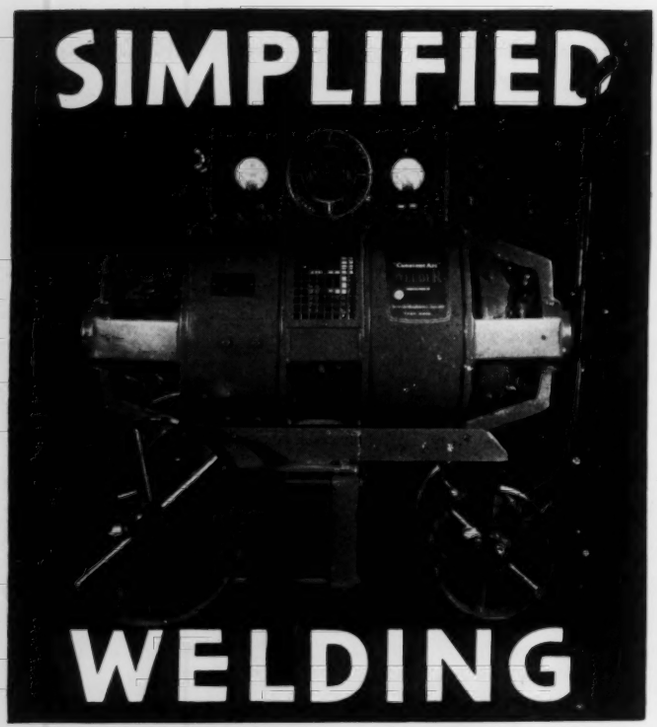
ROBINS CONVEYING BELT CO.

NEW YORK CHICAGO

Boston Philadelphia Pittsburgh
London, England Johannesburg, South Africa

Representatives

Birmingham.....*C. B. Davis Engineering Co.*
Picher, Okla.....*Ore Reclamation Co.*
El Paso (For Mexico).....*Ammex Equipment Co.*
New Orleans.....*A. M. Lockett & Co., Ltd.*
San Francisco.....*Joshua Hendy Iron Works*
Salt Lake City.....*The National Equipment Co.*
Seattle.....*B. F. Easterbrooks Co.*



..lets you RE-DESIGN
QUICKLY,
ECONOMICALLY

Cuts your costs and speeds the work in TWO WAYS—when you are designing new products or improving existing models.

FIRST—In tooling, where jigs, fixtures, tools, etc., are quickly whipped into shape by arc welding standard steel parts.

SECOND—In final manufacture, where arc welded steel cuts costs, reduces inventories, improves products and speeds production.

And with the "SIMPLIFIED WELDING" characteristics of the Hobart "Constant Arc" Welder, it's so easy to train your own workmen to do the work.

THREE-FOLD GUARANTEE OF SATISFACTION

(1) 30 Days Trial in your plant at our risk.
(2) Pay out of Savings it brings, if you wish.
(3) Built by "Successful Manufacturers Since 1893"

Write today for Bulletin E-9 and prices that mean savings of $50 to $150.

Hobart Bros. Co.
Box MD-91 Troy, Ohio

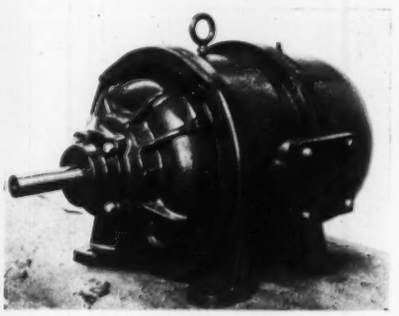
HOBART CONSTANT ARC WELDERS
SALES AND SERVICE IN PRINCIPAL CITIES

Co., Chicago Heights, Ill., exhibits the essential characteristics of standard heat treated manganese steel, namely toughness, ductility, resistance to abrasion and hardening under cold working. The high nickel content of the rod (approximately 5 per cent) overcomes any tendency of the metallic manganese content to oxidize and prevents embrittlement under slow cooling, which the rather high carbon content might cause in the absence of the high nickel content. Perfect welds can be made by relatively unskilled operators.

Announces Explosion Proof Motor

A NEW totally enclosed fan cooled squirrel cage motor for use in explosive atmospheres has been designed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., in accordance with and meeting the latest specifications of the National Board of Fire Underwriters for use in Class I, Group D, hazardous locations.

Free passage of cooling air is assured because of large air passages and large spaces between guard and the nonsparking aluminum alloy fan. Air inside the motor is kept in constant circulation by fan blades on each end of the rotor. The bearings are of cartridge type and have low maintenance and long life due to their location on the outside of bearing bracket where the heat is dissipated in the cool air stream. The prewound primary core is interchangeable and renewable. The heavy conduit box is so designed that it may be turned in any direction to receive conduit. These motors operate efficiently either indoors or outdoors.



Free passage of cooling air is assured in new totally enclosed, fan cooled, squirrel cage motor

Overloading Prevented in New Pumps

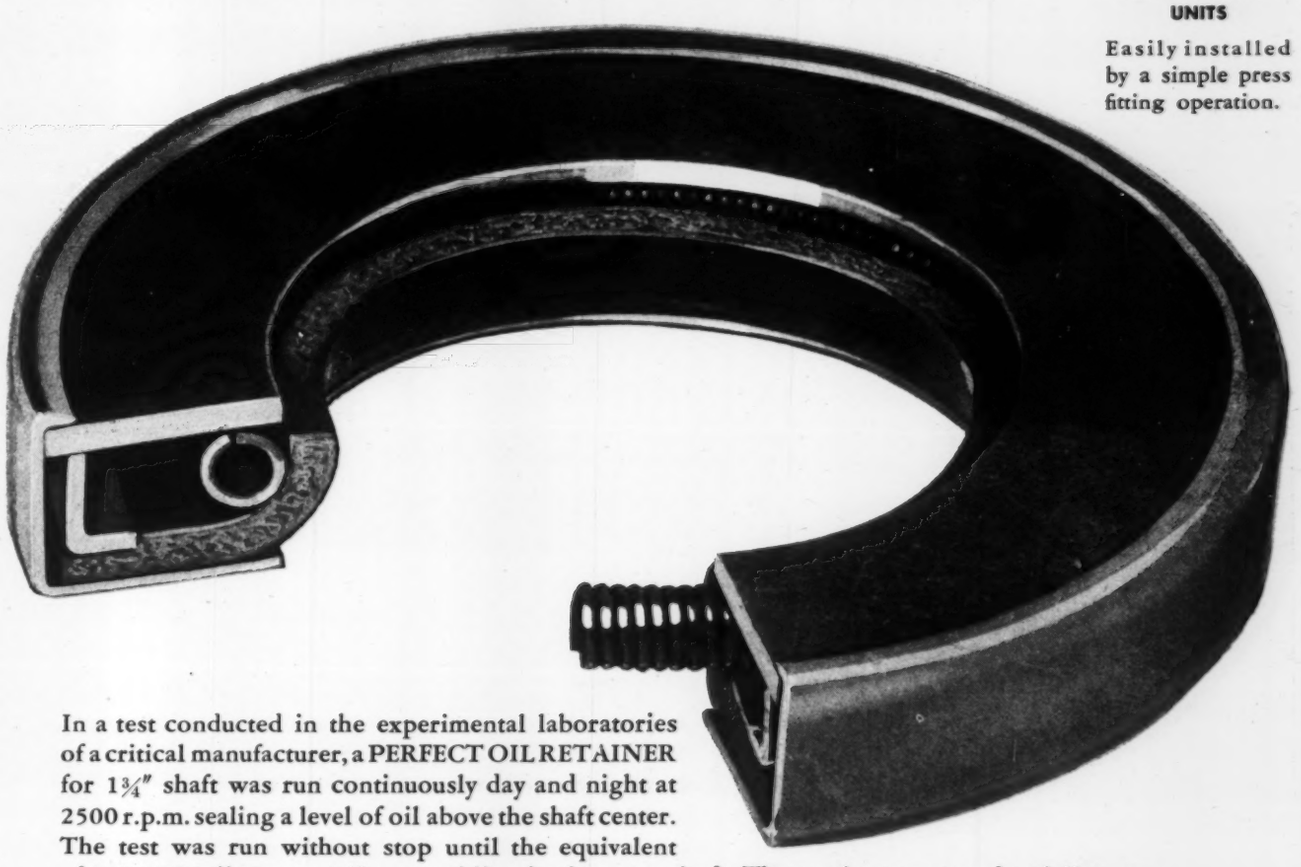
THE new type QR-2 high-pressure pump manufactured by Oilgear Co., Milwaukee, as described in the August issue of MACHINE DESIGN, has a maximum capacity of 1500 pounds per square inch. This was erroneously reported as 15,000 pounds per square inch. Overloading the pump, work and tools is prevented by an internal relief valve which can be adjusted according to the force required.

Convincing Evidence of Merit!

THE PERFECT OIL RETAINER *on test* CONTINUES TO *retain lubricant* AND *protect bearings* AFTER THE EQUIVALENT OF 900,000 AUTOMOBILE MILES

COMPACT SELF-CONTAINED UNITS

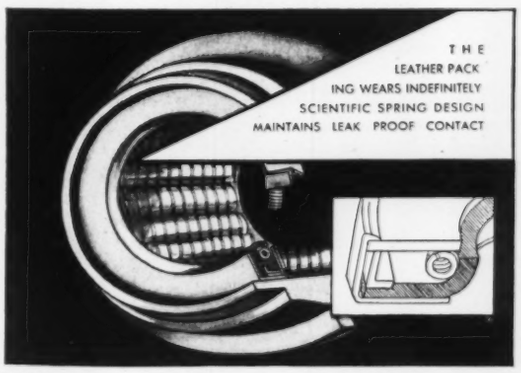
Easily installed by a simple press fitting operation.



In a test conducted in the experimental laboratories of a critical manufacturer, a PERFECT OIL RETAINER for 1¾" shaft was run continuously day and night at 2500 r.p.m. sealing a level of oil above the shaft center. The test was run without stop until the equivalent of 900,000 miles on a 34" automobile wheel was reached. The results were noted as follows:

THERE WAS NO LEAKAGE! THE PERFECT OIL RETAINER SHOWED NO WEAR!

From all indications, this seal would have continued functioning perfectly for another similar period. Our engineers will gladly cooperate with you in solving your oil and grease sealing problems. It is of utmost importance that your inquiry be accompanied by complete mechanical details.



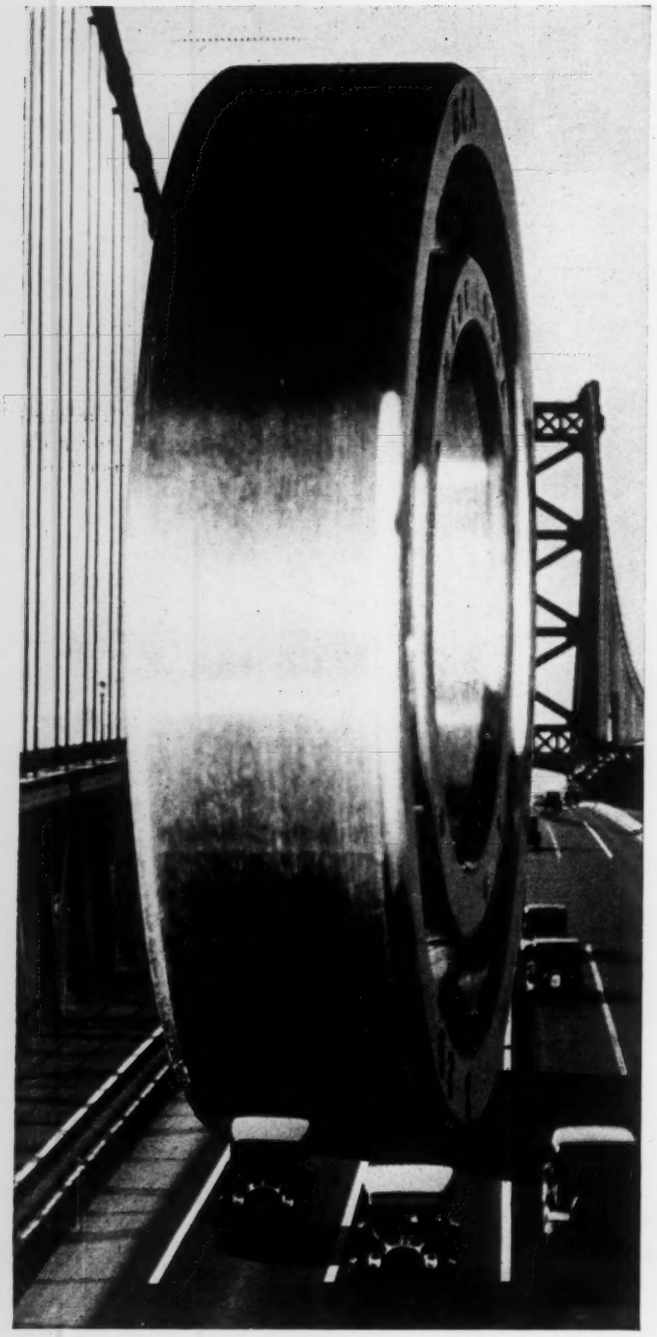
Perfect
OIL RETAINERS

The CHICAGO RAWHIDE MANUFACTURING CO.

1304 ELSTON AVE., CHICAGO

Branches: NEW YORK, DETROIT, CLEVELAND, PHILADELPHIA, PITTSBURGH

IF MADE OF LEATHER FOR MECHANICAL PURPOSES WE MAKE IT



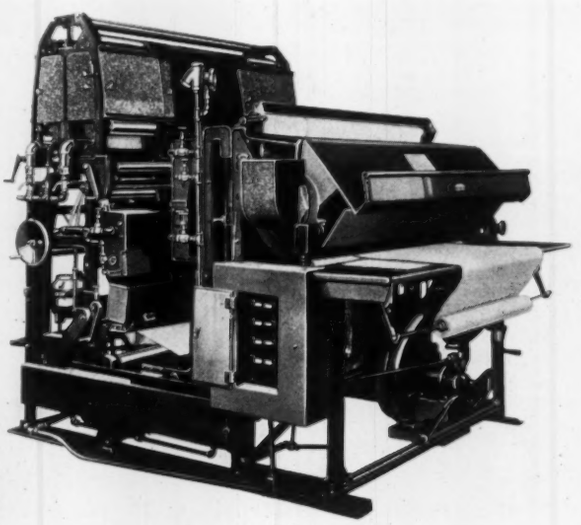
B. C. A. Annular Bearings are manufactured from HIGH CHROME HIGH CARBON STEELS. Every bearing rigidly inspected for accuracy and precision.

BEARINGS COMPANY
OF AMERICA
LANCASTER, PA.
DETROIT MICH. OFFICE: 1012 FORD BLDG.

New Blueprinting Machine Has Improved Drier

COMBINING many of the features of the "Peerless" model 20 and model 30 blue printing machines, the new model 25 continuous blue printing equipment announced by C. F. Pease Co., Chicago, was designed particularly to meet the demands of the moderate budget and the requirements for quality prints at the same time.

The new unit is operated similar to other models, and can be used to produce prints continuously or singly. All lamps in the equipment



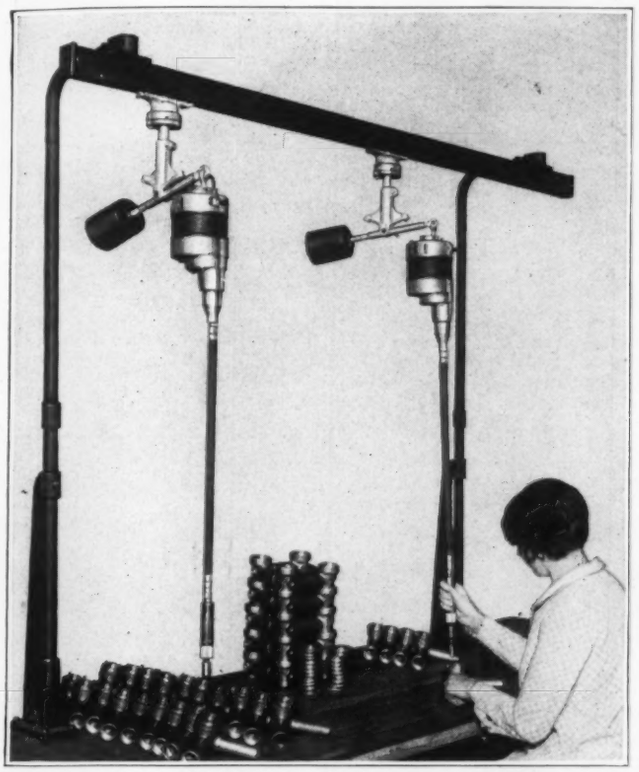
are mounted in horizontal alignment to give uniform light distribution and fast printing speed.

When printing continuously the prints on a continuous roll of paper pass down to the specially designed atomizer water wash consisting of spray jets which direct a pressure spray over the entire front and back surface of the paper. The prints then pass over in contact with the chemical roll applicator set in a shallow tray at the bottom center of the machine, which revolves in the same direction as paper is travelling and either potash or negative solution is applied uniformly over the entire surface of the prints.

The drier of the unit is entirely new in arrangement. It is a twin-radiator, air-type dryer consisting of two banks of heating units between which the paper travels, around a floating idler roll that can be raised or lowered thus making it easy to thread the paper through the machine.

Model 25 is available in two sizes, 42 and 54 inches wide, and the machines can be wired to operate on either 220 volts alternating or direct current. The blue-printing machine can be operated independently from the other equipment by means of a clutch arrangement, or it may be purchased separately.

▲▲▲ HOW BODINE MOTORS SERVE HASKINS AUTOMATIC SCREW DRIVERS



THE AUTOMATIC screw driver performs a once tedious operation at lightning speed. It drives screws "home" with a precision and uniformity never accomplished by old methods. Its variable spring tension on slip clutch gives adjustability for any standard back-off test. It is an invaluable time and money-saver in factory production lines.

The R. G. Haskins Company has developed an extensive line of motor-driven screw drivers with flexible shafts. Bodine Type NSI-54 Ball Bearing Induction Motor Assemblies are employed to power these units. These Bodine parts—stator, rotor, cut-out, and bearings—are assembled in the Haskins casing at the Bodine factory. They are engineered to careful specifications, the shaft in this instance being made of chrome nickel steel, and specially ground with fillets at the shoulders to prevent crystallization.

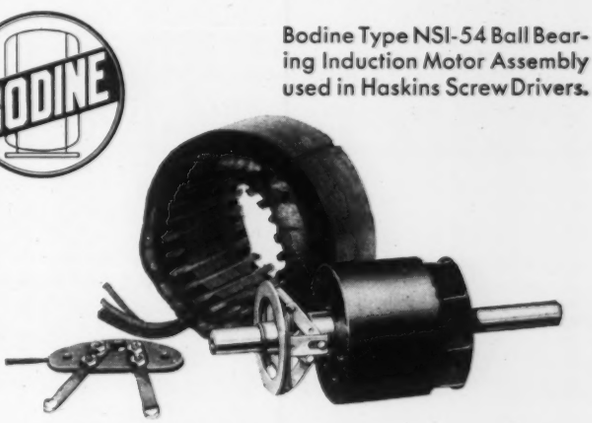
Similarly successful applications of Bodine Motors have been made on almost every type of machine requiring a fractional horsepower drive. Let Bodine engineers solve your problems, too.

WHY NOT SELL PERFORMANCE?

MOTOR-DRIVEN machines, tools, and appliances carry an added assurance of continuous service when equipped with Bodine Fractional Horsepower Motors. The keen competition of this era makes it dangerous to sacrifice quality. Manufacturers who look ahead to the building of a substantial business through confidence in their products cannot buy motors strictly on a price basis. Bodine Motors, engineered for your product, contribute that extra quota of performance and appearance which makes your product more salable.

Bodine Motors provide 1/1300 H.P. to 1/4 H. P. at standard speeds. Let Bodine engineers submit recommendations. Send for the new Bodine Illustrated Catalog.

BODINE



Bodine Type NSI-54 Ball Bearing Induction Motor Assembly used in Haskins Screw Drivers.

The Motorgram is a bimonthly message mailed free to manufacturers interested in small motors. Let us put your name on the Bodine mailing list.

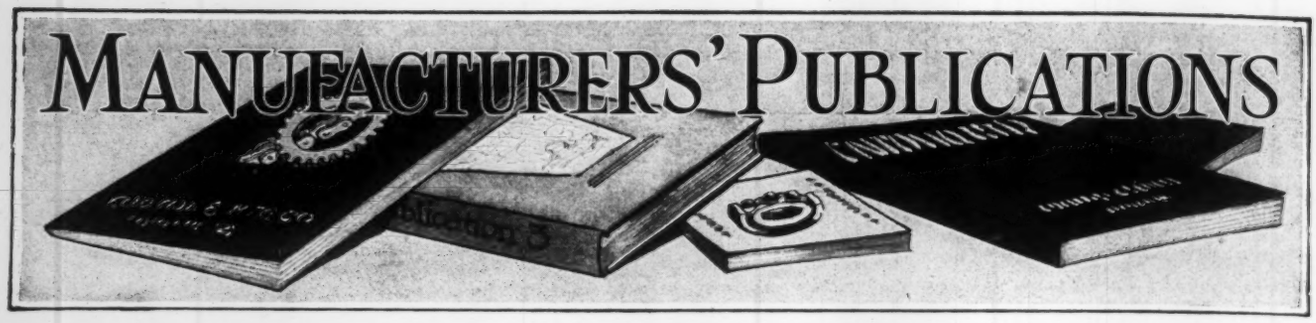
BODINE MOTORS
ENGINEERED FOR YOUR PRODUCT

BODINE ELECTRIC CO.
2258 W. Ohio Street, Chicago

Please send items checked below:
☐ Bodine Catalog ☐ Motorgram

Name.....
Title.....
Address.....

MANUFACTURERS' PUBLICATIONS



Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (NICKEL)—International Nickel Co., New York, has prepared recommended specifications for nickel alloy steel in railroad applications. The recommendations, presented in similar form to that used by the American Railway association, covers forging billets, engine bolt steel, staybolt steel, castings, cast iron for cylinders, normalized and tempered low-carbon forgings and similar applications.

BEARING MOUNTINGS—Ball bearing mountings and suggestions for design are treated comprehensively in a booklet prepared by Fafnir Bearing Co., New Britain, Conn. This booklet considers all types of ball bearing mountings and includes seal bearing applications and lubrication design.

BEARING MOUNTINGS—Simplified bearing and spindle mounting designs by the use of Wyromatick compensators is described in bulletin No. 102 issued by Wyrick Engineering Co., Wyandote, Mich. The bulletin gives details of the mountings, drawings illustrating installations, and dimensions of the equipment available.

CABLE—Outstanding applications of electric cables and an announcement of two new types are included in the August issue of *Beldenews*, issued by Belden Mfg. Co., Chicago.

CONTROLS (ELECTRICAL)—A new safety switch incorporating three important improvements is described in a recent folder issued by Square D Co., Milwaukee.

CONTROLS (ELECTRICAL)—Electric Controller & Mfg. Co., Cleveland, describes in a recent folder its No. 2 type ZO motor starter, a larger companion to its No. 1 type ZO starter. Eight outstanding features of this new type of starter are cited. Particular attention has been given to produce a starter of exceptional quiet and efficiency of operation.

CONTROLS (ELECTRICAL)—Burgess-Parr Co., Chicago, has published a folder on its vacuum contact, a new and improved device for use wherever a positive, rapid and durable electrical contact is required, in circuits handling up to 1300 watts at 220 volts. The contact depends upon the elasticity of a glass bellows in the mechanical actuation of contacts sealed in vacuum.

CONTROLS (ELECTRICAL)—General Electric Co., Schenectady, N. Y., has prepared new catalogs on industrial controls, and capacitors for power factor correction, a folder on controllers, and catalog inserts on: outdoor horn-gap switches; direct current printing press controllers; indoor alternating current cubicles; indoor disconnecting switches; combination magnetic switches; pole-changing switches; solenoid-operated valves; and outdoor fuse disconnecting switches.

DESIGN PROBLEMS—The application of die sets and die makers supplies to problems of design is described in the first issue of *Danly Guide Post*, a monthly magazine published by Danly Machine Specialties Inc., Chicago.

DRIVES—Built-in speed reducers for general purpose, ball bearing induction motors are described in a catalog insert prepared by General Electric Co., Schenectady, N. Y.

DRIVES—Cy-Lent worm gear speed reducers which have ratios from 5-1 to 3600-1 are described in a recent booklet issued by Timing Gears Corp., Chicago. Dimensions and general engineering data also are given.

DRIVES—The Kritzer Co., Chicago, has published an attractive data book giving specifications, applications and dimensions for its floating motor drive base. The booklet gives the theory of the base, and describes how it has been used to solve typical drive problems.

DRIVES—The values of tension in leather belting during all phases of operation are defined and described in an interesting article in the first edition of *The New Houghton Line*, published by E. F. Houghton & Co. Philadelphia. The publication also includes articles of general interest and pertinent comment on present day topics.

DRIVES—Morse Chain Co., Ithaca, N. Y., has issued bulletin 44 which gives a complete listing of stock drives manufactured by the company. The 56-page booklet includes a description of the equipment, lubrication methods, typical installations, and sprocket and miscellaneous data, as well as drive tables listing the drives by horsepower ratings at standard motor speeds from 720 to 1750 revolutions per minute.

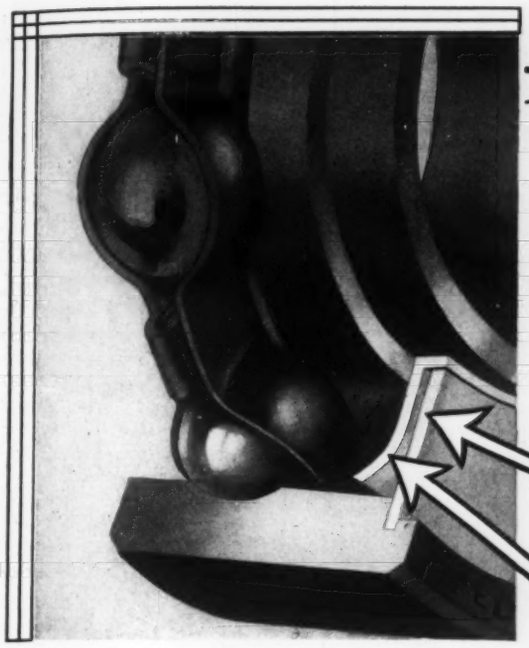
FINISHES—A booklet by E. I. du Pont de Nemours & Co., Wilmington, Del., on clear lacquer as a protective coating on metals illustrates the methods of scientific tests, test panels and includes a table of evaluations of 22 lacquers.

GEARS—Lukenweld Inc., Coatesville, Pa., has prepared a bulletin describing gear blanks made of arc-welded, rolled steel, a new development announced recently by the company.

GEARS—Earle Gear & Machine Co., Philadelphia, has prepared catalog No. 31, which contains photographs, tables, engineering data and formulas on gear design and the gears manufactured by the company. The tables give detailed dimensions and specifications for cast iron, steel and nonmetallic gears and pinions.

HEATING UNITS—Industrial heating devices for many uses are described in a recent folder by General Electric Co., Schenectady, N. Y.

MOTORS—General Electric Co., Schenectady, N. Y., has issued a number of catalog inserts describing and giving engineering data on type BTA alternating current motors,



A NEW and BETTER Grease-Sealed BEARING

No Felt, Leather, Cork or Other Injurious Materials Used

Only Grease-Sealed Bearing Which Does Not Depend Upon Harmful Sealing Agents to Keep Grease in and Foreign Matter Out

No frictional contact between rotating parts. Therefore no rising temperatures or over-heating at any speed. Free-running without any drag.

Efficiency of seal is mechanical. The Inner Impeller and outer seal form a vacuum pocket, preventing suction of foreign matter into the bearing.

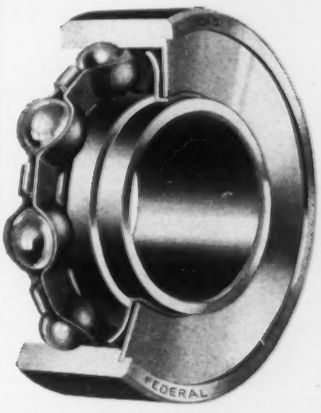
The Impeller continually throws grease into the races and onto the balls where it is required and the vacuum retains the grease.

Standard S. A. E. dimensions always maintained. Consequently no distortion in mounting—as in the case of bearings where outer ring has been reduced in diameter or width to take seal.

No loose parts. Impeller is securely pressed on inner bearing ring; outer seal is spun into recess in outer race ring.

Felt, leather, cork and other sealing agents eliminated. For this reason, fibre cannot get into the delicately adjusted bearing.

Absence of sealing agents also means that there is nothing to conduct lubricant outside of bearing—nothing to become hardened, torn and worn.



Patent Applied for

All Standard S. A. E. Annular sizes. Parts are formed to accurate measurements, so that grease will be retained and the bearing efficiently lubricated at any speed.

Federal VACUUM-SEAL Bearing successfully overcomes all the faults of the ordinary grease-sealed bearing and brings to manufacturers in all industries a new conception of bearing efficiency and performance.

FEDERAL VACUUM-SEAL

ALL-METAL BEARING

THE FEDERAL BEARINGS CO., INC., POUGHKEEPSIE, N. Y.

Associated with

The Schatz Manufacturing Company, Poughkeepsie, N. Y.

Manufacturers of Commercial Annular Ball Bearings

Detroit Sales Office, 917 Book Bldg.—Chicago Sales Office, 120 N. Peoria St.

GREASE CAN'T GET OUT . . . INJURIOUS MATTER CAN'T GET IN

SAVE ON YOUR MOLDED PARTS—THE Auburn WAY

Here's an Instance—

where Auburn Engineers were able to help a certain manufacturer make a considerable saving on finishing and assembling costs and at the same time make a more convenient and beautiful appearing product.

This twenty outlet panel for curling machines is molded of beautiful Bakelite in ONE PIECE. Note the extremely intricate design of the back. Forty-three brass connection inserts are molded right in the plate at three different depths.

Analyze your product! — what are the physical characteristics needed in each component part? They can invariably be molded of celluloid or phenolic compound parts of equal or better advantage than the material you are now using—and for less cost.

Give Auburn Engineers a chance to consider your "cut cost" problems.

Write us today.

Celluloid-Bakelite Division

Auburn Button Works, Inc.

Auburn, N. Y.

Auburn

Since 1876

Molders of CELLULOID and PHENOLIC COMPOUND PARTS also LUMARITH, CELLULOSE ACETATE, ALDUR.

type K general purpose squirrel-cage industrial motors, types K and KF solid-shaft vertical induction motors, explosion-proof totally enclosed motors, fan-cooled induction motors, type CD adjustable speed direct current motors, type BD direct current motors, type CD constant speed direct current motors, type K totally enclosed, fan-cooled motors, alternating current double motor equipment for rotary web newspaper presses, and brakes for direct current motors.

MOTORS—"Bullet type" vertical hollow shaft motors for deep well pumping service are described in a recent bulletin issued by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Another bulletin issued by the company is a 4-page leaflet describing its new mill motor.

PACKING GLANDS AND PACKING—A handy reference manual containing nearly 100 pages of new and authentic data concerning gaskets, gasket materials, and packings for industrial and commercial uses has been prepared by Victor Mfg. & Gasket Co., Chicago. Metallic gaskets, nonmetallic gaskets and rod and sheet packings are described and dimensions given.

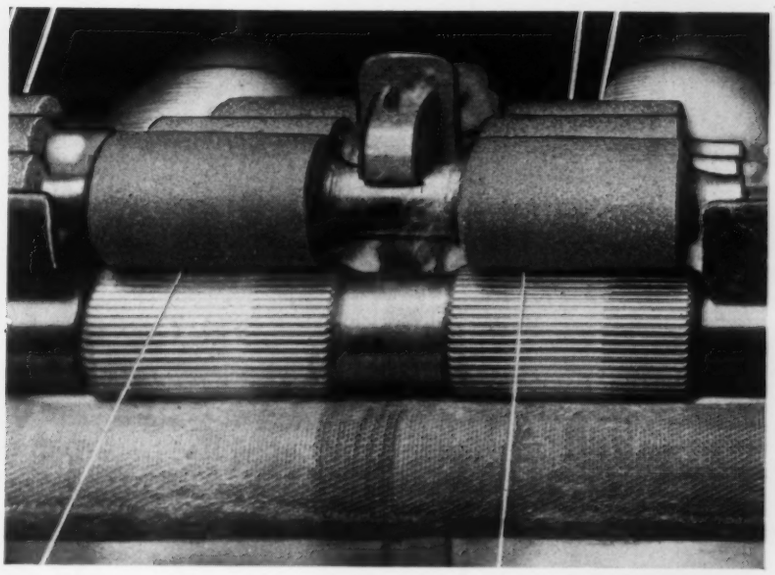
PANELBOARD—The switch panel division of Square D Co., Detroit, has just issued a supplementary section to bulletin CA-505 which describes its new shallow type convertible safety panelboard with capacities up to and including 100 amperes, 250 volts.

PLASTIC PRODUCTS—A booklet giving a description and strengths of plastic products manufactured by General Electric Co., Schenectady, N. Y., is presented by the company.

PUMPS—Rollway relief valve coolant and lubricant pumps manufactured by Pioneer Engineering & Mfg. Co., Detroit, are described in a recent folder issued by the company. The pumps are suited to many purposes and will pump any kind of liquid. There are no gears to jam on foreign matter that may pass into the pump chamber.

PUMPS—Northern Pump Co., Minneapolis, has prepared an unusually attractive catalog, No. 2G, picturing rotary pumps made by the company, each type designed for a special service. The 35-page book has each page devoted to a type pump, on which are pictures of installations, short descriptive matter, and outlined engineering data and specifications. The company has also prepared catalog No. 3G on its Nitralloy rotary pump and bulletin PX2 on the same equipment. These two publications give complete engineering knowledge on the Nitralloy pump, including installations, specifications, and similar data.

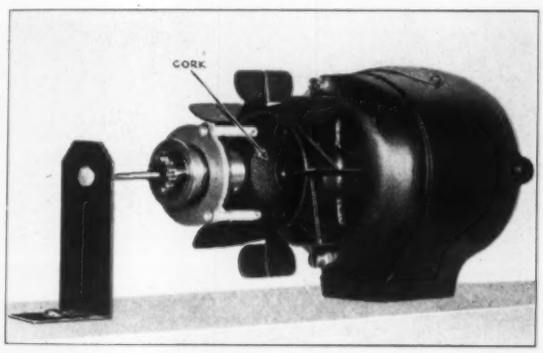
WIRE ROPE—A new 280-page wire rope and wire handbook presenting practically all information useful to the person buying or using wire rope has been issued by John A. Roebling's Sons Co., Trenton, N. J. It is profusely illustrated, carries ample tables, and depicts many of the important installations in recent years. The introduction relates how from the production of steel itself to the finished product the manufacture is controlled by the Roebling Company.



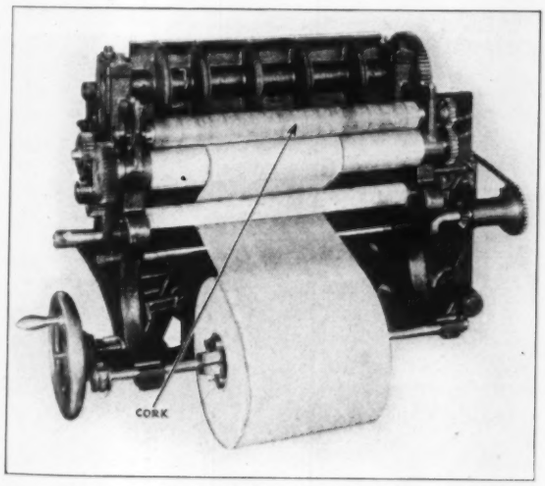
A DELICATE JOB! *Cork covered rolls, friction driven by metal rolls beneath, have proved their superiority over other types of rolls used in drawing and spinning cotton yarn. Cork lasts four times as long as the leather covering it replaced and produces yarn of equal or better quality.*

Cork SAVES THOUSANDS *of* DOLLARS ANNUALLY *in* TEXTILE MILLS

Answers need for a better material for friction driving, drafting, and braking



FOR DRIVING TOO! *Armstrong's Cork is used as a friction facing in the motor and clutch assembly of the Eastman Kodascope projecting machine.*



ARMSTRONG'S CORK WRAPS GUM. *A cork covered roll measures and feeds the paper in this machine made by the Battle Creek Wrapping Machine Company. Waxed paper, foil, cellophane, etc., are handled safely and positively by cork.*

ONE of the major production economies effected in the textile industry in recent years has been the development of Armstrong's Cork Rolls or "Cots" for drawing and spinning cotton yarn. Through a combination of frictional efficiency and lively resilience, cork grips the cotton fibres and transforms them into finished yarn. It allows no slippage, resists static electricity, stays resilient, and lasts four times as long as other types of rolls, thus cutting production cost materially.

Looms, warpers, winders, and other textile mill machinery also use cork for friction driving and braking services. Other industries likewise employ cork in operations depending on friction. It is used in numerous types of machinery where there must be no slippage in friction facings, and where the release and pick-up action must be positive and immediate.

Due to its unique air-cell structure, cork retains its life and "come-back" under conditions that quickly cause other materials to harden. Oil and grease will not cause cork to deteriorate or materially lessen its frictional efficiency.

Submit your problems to our Industrial Service Section. The properties of Armstrong's Cork can be controlled to meet a variety of needs. Armstrong Cork Co., 918 Arch St., Lancaster, Penna.

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